Final Working Paper 3

Air Quality Conformity Procedures

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1.0 Introduction

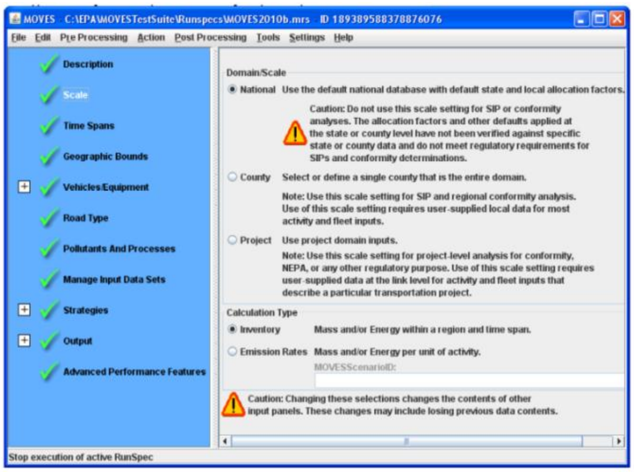
The objective of Working Paper 3 (WP-3) is to provide recommendations for conducting transportation regional and project-level conformity analyses in areas outside of the Maricopa Association of Governments (MAG). The paper includes an overview of past procedures, a discussion on key modeling issues related to EPA's MOVES emission model, and recommendations for developing a technically robust analytical framework based on available local data. Project-level conformity procedures are also addressed with a concentration on project screening methods, interagency consultation, and key technical analysis and data items that will impact future project-level studies.

This document is intended to complement the technical items and details recommended in available EPA guidance documents including:

- *Technical Guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity*, April 2010, EPA-420-B-10-023
- *Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas*, December 2010, EPA-420-B-10-040

The available EPA guidance provides some flexibility in developing roadway emission inventories in support of transportation conformity and State Implementation Plans (SIPs). This flexibility is based on available local data, analytical tools, and other resource constraints. As a result, the recommendations provided in this paper include options representing different levels of technical robustness and quality control. The recommendations include best practice approaches that have been utilized in other regions within the country.

2.0 Overview of EPA's MOVES Emission Model



MOVES is the state-of-the-art upgrade to EPA's modeling tools and is the current official model for estimating emissions from highway vehicles replacing the previous MOBILE6.2 model. MOVES was developed by EPA's Office of Transportation and Air Quality (OTAQ). As required by the Clean Air Act (CAA), EPA regularly updates its mobile source emission models. This latest model incorporates several changes to the EPA's approach to mobile source emission modeling based upon recommendations made to the Agency by the National Academy of Sciences. Compared to previous tools, MOVES incorporates the latest emissions data, more sophisticated calculation algorithms, increased user flexibility, new software design, and significant new capabilities.

Unlike EPA's previous mobile source emission models, MOVES has a graphical user interface (GUI) which allows users to more easily set up and run the model, though the model can still be run in batch mode to support linkages to other processing software. More fundamentally, it has been designed to do calculations with information in databases, using the open source database management software known as MySQL.

EPA announced the release of MOVES2010 in March 2010 (75 FR 9411), and released a minor revision as MOVES2010a in September 2010. In April 2012, EPA released MOVES2010b to allow MOVES users to benefit from several improvements to general model performance. MOVES2010b does not affect the criteria pollutant emissions results of MOVES2010a and therefore is not considered a new model. MOVES is required for new regional emissions analyses for transportation conformity determinations that began after March 2, 2013 (77 FR 11394). As summarized in **Table 1**, EPA has developed several guidance documents to assist in implementing MOVES.

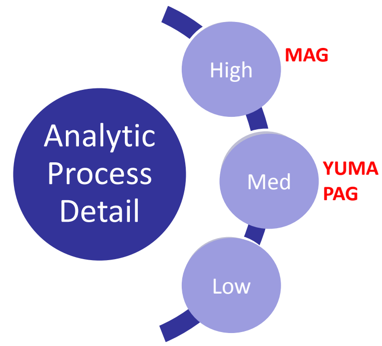
EPA is in the process of developing a major update to the MOVES model (MOVES2013). The update will incorporate new functionality, research and emission factors. Planned improvements include upgraded diesel retrofit processing, improved evaporative emission processing, better performance, and other various improvements. MOVES2013 is anticipated to be released in late 2013. Major structural changes are not anticipated as many agencies have already developed customized tools based on the structure and formats of MOVES2010.

Table 1: EPA Guidance Documents for MOVES

Topic	Document
General Operation of MOVES Model	• *Motor Vehicle Emission Simulator, User Guide for MOVES2010b*, EPA-420-B-12-001b, June 2012.
Use of MOVES for Conformity and SIP Analyses	• *Policy Guidance on the Use of MOVES2010 and Subsequent Minor Revisions for SIP Development, Transportation Conformity, and Other Purposes*, US EPA Office of Air and Radiation, EPA-420-B-12-010, April 2012. • *Using MOVES to Prepare Emission Inventories in State Implementation Plans and Transportation Conformity, Technical Guidance for MOVES2010, 2010a and 2010b*, US EPA Office of Air and Radiation, and Office of Transportation and Air Quality, EPA-420-B-12-028, April 2012.
Use of MOVES for Project-Level Analyses	• *Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas, US EPA Office of Air and Radiation*, EPA-420-B-10-040, December 2010. • *Using MOVES in Project-Level Carbon Monoxide Analyses*, US EPA Office of Air and Radiation, EPA-420-B-10-041, December 2010.
Use of MOVES for Greenhouse Gases	• *Using MOVES for Estimating State and Local Inventories of On-Road Greenhouse Gas Emissions and Energy Consumption*, US EPA Office of Air and Radiation, EPA-420-B-12-068, November 2012.

3.0 Assessing Past Analysis Procedures

Emission analyses conducted by MAG, the Yuma Metropolitan Planning Organization (YMPO), and the Pima Association of Governments (PAG) were reviewed to assess past practices in computing roadway emissions using EPA's MOBILE6.2 emission model. The review was based on the information and details provided in the transportation conformity and regional plan documents. For each of these areas, a regional TransCAD travel demand model has been used as the traffic data source for vehicle miles of travel (VMT) and speeds. Other key inputs are based on local data as recommended by EPA guidance. These include:



- registration data to determine the vehicle fleet ages
- local environmental data including temperatures and humidity
- regional fuel characteristics
- local control strategies including the vehicle inspection and maintenance program

MAG's analysis approach fully utilizes MOBILE6.2 capabilities and satisfies procedures recommended in EPA guidance

The methodology differences between these areas primarily relate to the methods used in applying emission factors from MOBILE6.2 to the available traffic data. The analysis detail is determined by the types of pollutants being analyzed and the purpose of the emission analysis results. **Table 2** highlights specific features of the calculation methods in each area as compared to best practices.

MAG has produced emission analyses to support regional conformity determinations for carbon monoxide (CO), ozone and PM_{10}. Custom software (M6Link) is used to assist with batch processing, the development of speed inputs to MOBILE6.2, and the application of emission rates to aggregated VMT totals. Within the software, travel model volumes by time period are expanded to each hour of the day to support diurnal analyses accounting for the variance of emission factors by environmental conditions. The M6Link software is used to prepare a distribution of link speeds by time period for input to MOBILE6.2. The approach conducted by MAG fully utilizes EPA's MOBILE6.2 capabilities and satisfies the procedures recommended in EPA guidance. This approach is consistent with best practice approaches including those used throughout the northeast (Pennsylvania, Maryland, New Jersey, and New York). One key difference between MAG's process and other best practice approaches is the lack of speed post processing from the travel model. However, MAG has conducted speed validation efforts to affirm the calculated speeds from the travel model are consistent with observed peak and off-peak conditions.

YMPO has conducted transportation conformity analyses for PM_{10}. The methodology assumes a more simplistic application of emission factors as compared to MAG. Daily VMT estimates are multiplied by a single average emission factor. In this respect, the changes of VMT and emission factors by hour of the day are not specifically accounted for in this

The YMPO analysis approach does not address the variance of speeds by time of day. MOVES PM emissions factors are sensitive to speed approach. In addition, the emission factors are based on a single daily average speed and not a distribution of speeds by time period. Since PM_{10} emissions do not vary by speed in MOBILE6.2, the simplified approach for preparing speed inputs is acceptable. However, as illustrated in **Figure 1**, EPA's MOVES emission model does adjust $PM_{2.5}$-related emission factors by speed and engine operation, so future application of this approach does not meet EPA guidance recommendations.

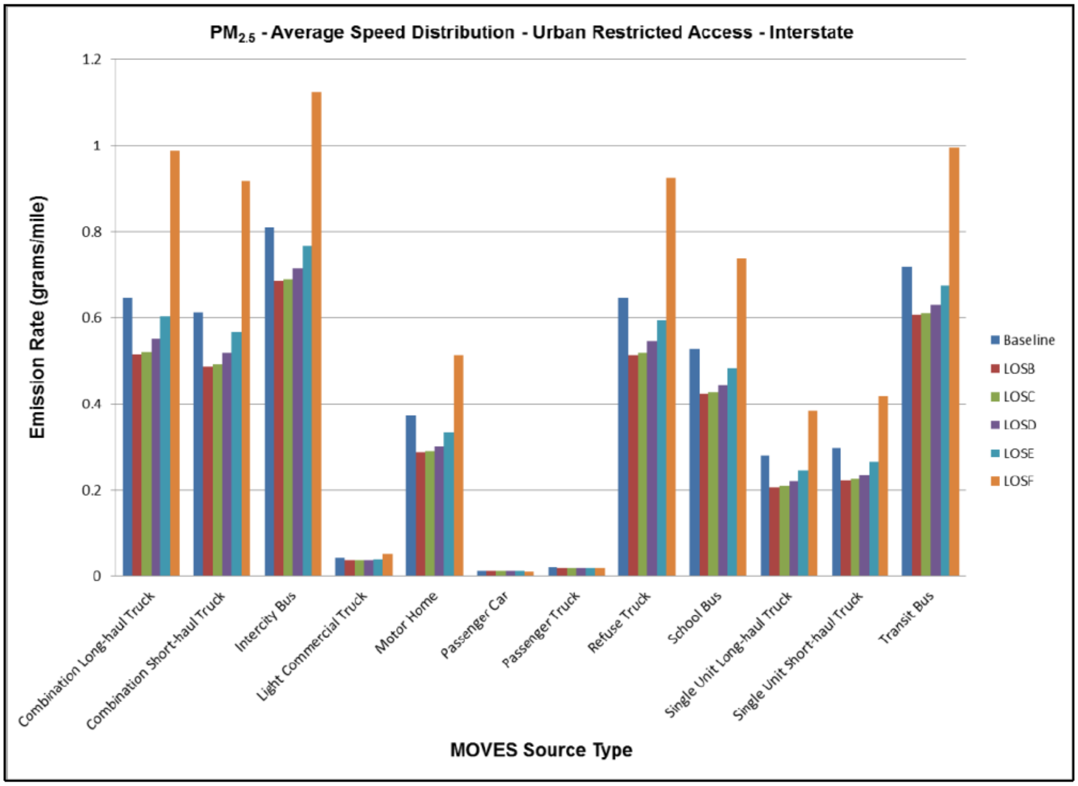
Table 2: Evaluation of Past Emission Analysis Procedures

Area (MPO)	Strength of Approach	Differences from Best Practices
MAG	• Automated batch processing improves quality control • Software incorporates AP-42 emission factors for re-entrained road dust • Utilizes local data for key inputs recommended by EPA guidance. • Emission factors are applied to each hour of the day accounting for variances in hourly environmental conditions and traffic volumes. • Traffic speed inputs to MOBILE6.2 are developed for distinct time periods and account for distribution of speeds across all links. • Approach includes method to account for I/M and non-IM vehicles	• No re-calculation of travel model speeds using post processing algorithms due to validation of speed data conducted by MAG
YMPO PAG	• Simplified analysis procedures allow emissions to be estimated quickly. • Analysis detail consistent with fact that PM emissions do not vary by speed in MOBILE6.2. • Utilizes local data for key inputs recommended by EPA guidance.	• Lack of customized automated procedures • Accounting for variance of emission factors and travel speeds by time of day. • No re-calculation of travel model speeds using post processing algorithms.

PAG has a CO limited maintenance plan and thus a regional emissions analysis for CO is not required in determining conformity of transportation plans and programs. However, modeling of the regional CO emissions is used for comparative purposes within the Regional Transportation Plan (RTP). The PAG RTP does not provide a detailed methodology for emission calculations, though the methods appear to be conducted using methods more consistent with YMPO.

Past methods used to produce emissions do vary among the three regions discussed. As EPA's MOVES model is integrated into the conformity process, past methods may need to be revised or enhanced to utilize the full capability of MOVES and to improve quality control and management of data files. MAG's current process addresses many of EPA's guidance recommendations and is consistent with best practice approaches in other states. The following sections will provide more details on the MOVES model and provide key analysis considerations that draw on these past practices and other best practices approaches for emission estimation.

Figure 1: Sensitivity of $PM_{2.5}$ to Vehicle Speed in MOVES Emission Model



* *$PM_{2.5}$ Average Speed Distribution Sensitivity Urban Restricted Access – Interstate*
MOVES2010a Regional Level Sensitivity Analysis December 2012
DOT-VNTSC-FHWA-12-05 (http://ntl.bts.gov/lib/46000/46500/46598/DOT-VNTSC-FHWA-12-05.pdf)

4.0 Assessing Available VMT Data Sources for Air Quality Analyses

Vehicle miles of travel (VMT) is the primary traffic input that affects emission results. MOVES requires annual VMT to be input for six HPMS vehicle classes. The format and issues related to the development of the MOVES VMT input file is discussed in **Section 5**. Typically, roadway VMT is estimated from an MPO regional travel demand model since it provides a robust method for estimating future forecasts of VMT related to demographics. Travel models are also a valuable tool since they can estimate the traffic impacts and diversions related to transportation projects. Where regional travel models are not available, state DOT's or MPOs have often relied on statewide travel demand models or the traffic databases used to develop VMT estimates for the Highway Performance Monitoring System (HPMS).

4.1 Summary of Available VMT Data Sources in Arizona

Table 3 provides a summary of available VMT data sources in Arizona. ADOT's statewide travel model serves as a valuable data source for areas without MPO models due to its robust roadway coverage, continued maintenance and validation by ADOT, inclusion of multiple time periods, and its truck model component.

Table 3: Available VMT Data Sources in Arizona

Data Source	Potential Uses	Key Characteristics
MPO Model	• Conformity • SIP Inventories	• Available for MAG, PIMA, YMPO nonattainment areas • MAG model contains speed validation
Statewide Model	• Conformity • SIP Inventories	• Consistent with HPMS roadway coverage across state • Contains additional detail of MPO models and enhanced detail for Pinal County • Four time periods (AM, Midday, PM, Night) • Addition of Mode choice component in process • Validated to 2008 conditions (in process to validate to 2010) • Speeds have not been validated • Estimates Single Unit and Multi-Unit trucks (Short haul base on MAG truck model, Long-Haul based on FHWA FAF data)
HPMS VMT	• SIP Inventories • Investigative Efforts • EPA NEI	• Summary VMT totals by county lack detail for speed estimation • VMT by time of day is not supported directly • Includes methods to estimate local VMT
HPMS Source Traffic Databases	• Conformity • SIP Inventories • EPA NEI	• Used to support model validation • Contains roadway characteristics, speed limits and intersection signal information (not comprehensive coverage) that could be used for speed estimation • Incorporates truck count data that can support vehicle type disaggregation

These characteristics of the statewide model allow for:

- calculation of VMT by time period to support MOVES emission rates by time of day;
- estimation of travel speeds using roadway capacity information and travel time data; and,
- disaggregation to vehicle types using link-specific truck forecasts in combination with other data sources including MOVES national defaults, national transit data, and vehicle registration information from the state.

The HPMS traffic databases also have information that could be used to support emission analyses. These databases contain traffic volumes and physical attribute information (e.g. travel lanes, facility class) that may be used to calculate VMT and travel speeds. However, these databases have several key deficiencies that include the lack of forecasted travel volumes, time period volumes, and traffic diversion methodologies to account for the impact of transportation projects.

Based on the above deficiencies, it is anticipated that the non-model data sources (in **Table 3**), including the HPMS VMT summaries, HPMS traffic database, and permanent traffic count stations, will complement the regional and state travel models in completing regional conformity and SIP emission estimates. These data sources can be used to develop important adjustments to the VMT forecasts including:

- seasonal and daily adjustments to convert model VMT to the required seasons for each pollutant (e.g. ozone = summer weekday, PM = daily or annual that may require an estimate of an average day in each month); and
- HPMS VMT reconciliation to ensure that base year VMT totals are consistent with the totals reported to FHWA. This will include accounting for missing local VMT not accounted for in the regional/state travel models.

Many states have been utilizing the HPMS traffic databases to support submittals for EPA's triennial National Emissions Inventory (NEI). Since HPMS is continually updated based on traffic counts and roadway inventories, it serves as a valuable data source for monitoring traffic conditions. In Pennsylvania and Maryland, these databases have been linked to the MOVES emission model using custom processing software to provide an automated method to produce the MOVES traffic and average speed inputs needed for every county in each state.

4.2 Key Issues Integrating the ADOT Statewide Model

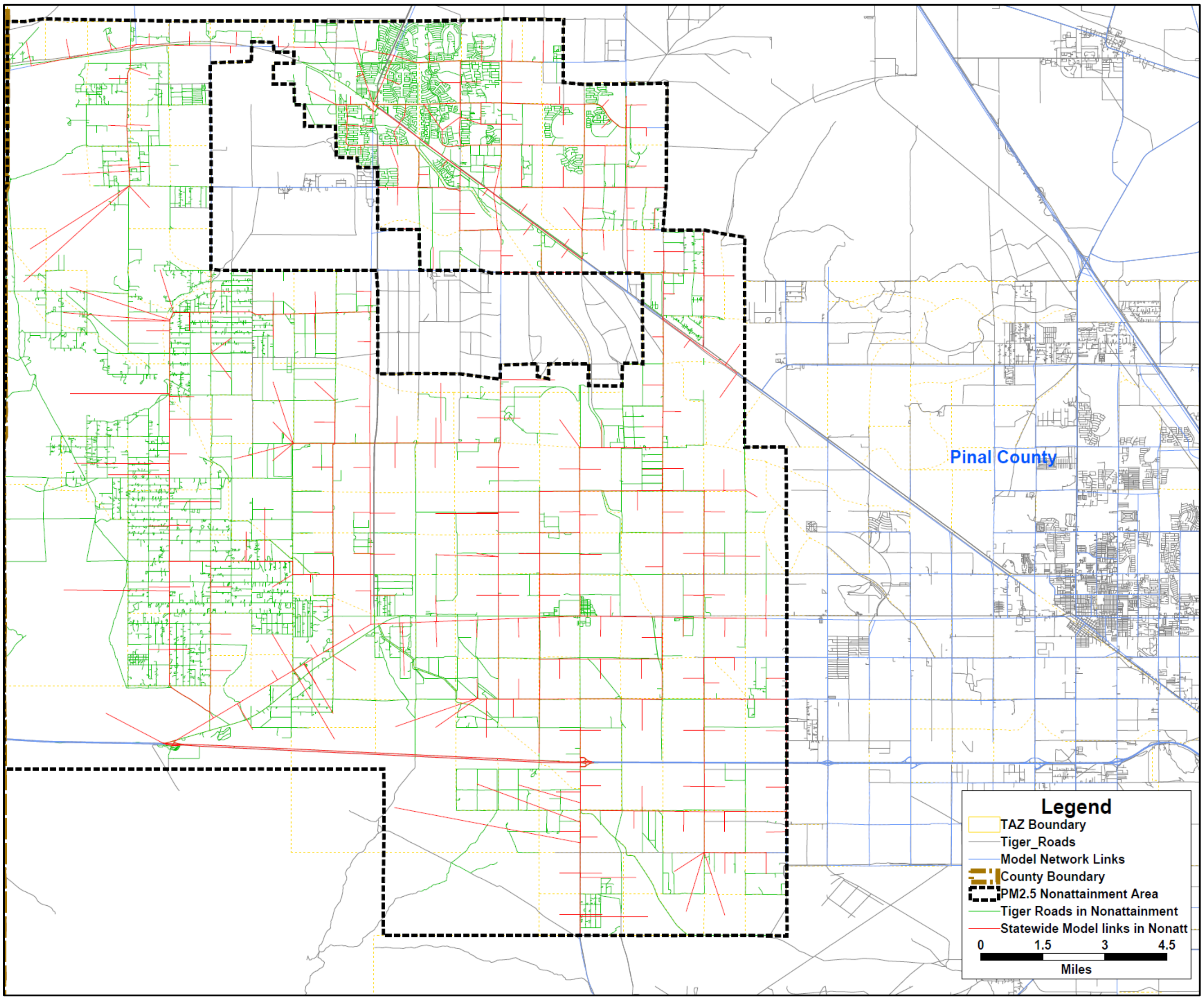
The MPO regional travel models will serve as the primary data source for emission estimates. For areas not covered by an MPO model or to support statewide performance measure analyses, the use of ADOT's statewide travel model is recommended. The statewide model has been the primary data source used for ADOT's sample analyses and will be the focus of future work in developing a case study approach.

The model provides the key information needed to produce the VMT and speed estimates (with potential post processing) for input to the MOVES model. In addition, the statewide model's roadway coverage is consistent with the state HPMS system with enhanced detail for MPO regions.

As illustrated in **Figure 2** (sample for CAG $PM_{2.5}$ area), there are still a significant number of local roadways not included in the statewide model network, as is the case for many regional travel models. This emphasizes the need for additional VMT adjustments and reconciliation.

The statewide model has various data fields that can be used to support the development of VMT, traffic speed distributions, and vehicle type inputs to the MOVES air quality model. Key network fields that may be used for air quality processing include those provided in **Table 4**. Traffic volumes and roadway distances can be directly used to estimate regional VMT. Traffic speeds can be translated to MOVES input file formats to support the detailed hourly speed data recommended for air quality processing. Truck volumes can be used as the basis for assembling VMT by the MOVES six HPMS vehicle classes. The use and application of the travel model data may require additional pre/post processing as described in **Section 5** and **6**.

Figure 2: Statewide Model Coverage for CAG $PM_{2.5}$ Nonattainment Area



** TAZ refers to model Traffic Analysis Zone system*

Table 4: Potential Statewide Model Fields for Air Quality Processing

(Based on Statewide Model Version 5 User's Guide)

Model Field	Description	Potential Use
Variables in the Input Highway Network		
Length	Length (mi), automatically computed from TransCAD	Estimation of VMT
FT	Facility type (1=freeway, 2=major arterial, 3=minor arterial, 4=collector, 5=minor collector, 7=ramp, 8=metered ramp, 9=centroid connector)	Lookup of other link attributes (e.g. speeds, signal densities, capacities) for speed recalculation in post processing routines
AREATYPE	Area type (1=CBD, 2=Outlying CBD, 3=Urban, 4=Suburban, 5=Rural, 6=Out-of-State)	Lookup of other link attributes (e.g. speeds, signal densities, capacities) for speed recalculation in post processing routines
AB_SPEED BA_SPEED	Link posted speed limit (mph)	Free-flow speed used if recalculating congested speed in post processing routines
AB_LANES BA_LANES	Number of lanes	Used to estimate capacity
Intermediate Variables Appended to HWY.DBD File		
AB_CAP_*AM* BA_CAP_*AM* (*AM, MD, PM, NT*)	Total capacity for the period (factored by lanes and hours)	May have limited use for recalculation of speeds in post processing routines.
AB_CAP BA_CAP	Capacity in vehicles per hour per lane	
AB_BPR_*A* BA_BPR_*A* (*A, B*)	BPR alpha(A) and beta(B) parameters	Possible use in post processing routines for speed recalculation.
Variables from the Output Assignment (*.Bin) Files (for AM, PM, Midday, and Night Time Periods)		
AB_FLOW BA_FLOW	Total flow of all vehicles	Estimation of VMT
AB_FLOW_SUT BA_FLOW_SUT	Flow of single-unit trucks	Use for vehicle disaggregation of VMT
AB_FLOW_MUT BA_FLOW_MUT	Flow of multi-unit trucks	Use for vehicle disaggregation of VMT
TOT_VHT	Total vehicle hours of travel	Use in preparation of MOVES speed distribution file which is based on distribution of VHT by speed bin
AB_SPEED BA_SPEED	Loaded (congested) speed	Use in preparation of MOVES speed distribution file. Reflect speeds by time period.

4.3 Adjusting VMT from Available Data Sources

Travel demand models will typically serve as the primary highway data source for the county and functional class VMT estimates. However, the models do not contain all the roadways in each region. **Table 5** illustrates a comparison of the ADOT statewide model roadway mileage as compared to the CENSUS GIS Tiger roadway layer. Although most of the VMT will be covered by roadways in the statewide model, there is a portion of missing collector and local VMT that will need to be accounted for in the emission methodology.

Table 5: Roadway Mileage Coverage in Statewide Travel Model

(Note much of the differences in mileage are local roadways with low traffic volumes)

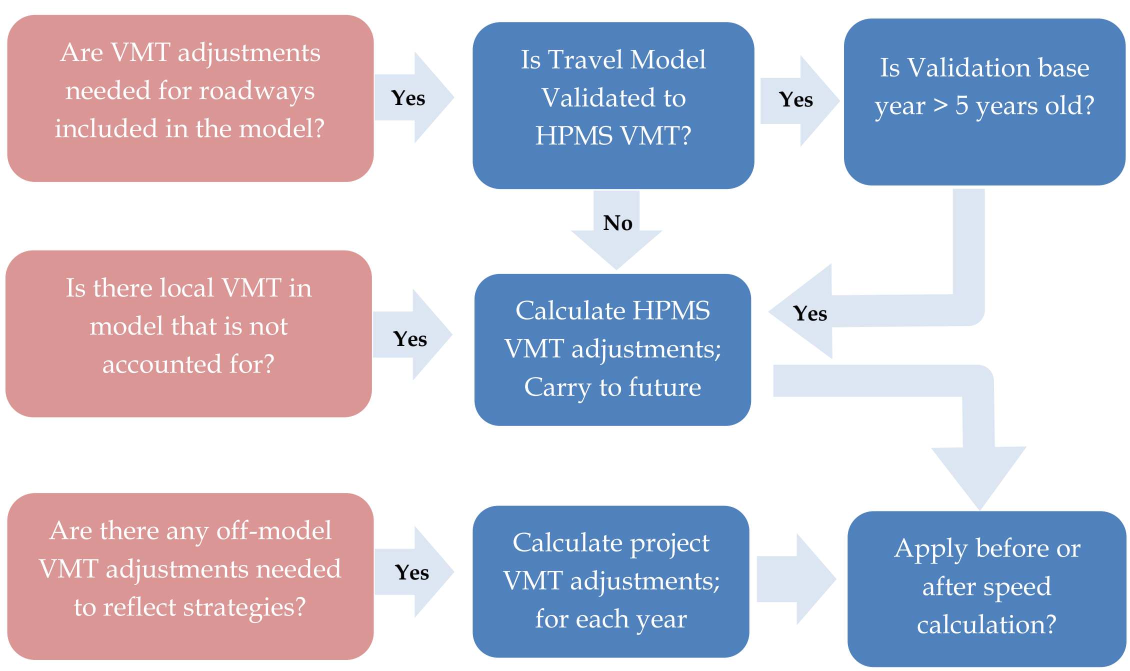
Nonattainment Area	Statewide Model Roadway Mileage	CENSUS TIGER Roadway Mileage
MAG 8-hr Ozone	7,422	28,796
CAG 8-hr Ozone	194	978
CAG $PM_{2.5}$	397	1,233
SEAGO $PM_{2.5}$	97	422
MAG PM_{10}	6,531	23,400
CAG PM_{10}	2,244	7,415
PAG PM_{10}	317	972
SEAGO PM_{10}	190	948
WACOG PM_{10}	679	2,182
CAG SO2	60	333

According to EPA guidance, baseline inventory VMT computed from available traffic sources must be adjusted to be consistent with HPMS VMT totals. The HPMS VMT reported for Arizona is a subsystem of a roadway and traffic database established to meet the data reporting requirements of the FHWA. Although it has some limitations, the HPMS system is currently in use in all 50 states and is being improved under FHWA direction.

Other VMT adjustments to the travel model outputs may include project specific adjustments based on off-model analyses. These may include regional TDM strategies or other VMT reducing measures.

Figure 3 illustrates the key decisions in assessing what VMT adjustments may be needed for the travel model data source as part of a regional emissions inventory. Note that additional seasonal and hourly adjustments are discussed separately in **Section 5**. Typically, travel model validation efforts include an assessment and adjustments to ensure the model properly reflects the right amount of travel for higher functional classes (e.g. freeway, arterial). However, adjustments may still be needed if the model validation is not recent of if the model is missing a significant amount of collector or local VMT. In those cases, an assessment should be conducted to verify if the travel model is producing reasonable VMT estimates for a more recent analysis year. If separate adjustments are needed, adjustment factors should be calculated and used to adjust the travel model base year VMT to the reported HPMS VMT totals submitted to FHWA. The VMT contained in the HPMS reports are considered to represent average annual daily traffic (AADT). Adjustment factors can be developed for each county and functional class grouping and applied to all future analysis year runs. Adjustments for the "higher" functional classes (e.g. Freeway, Arterials - major routes) should be close to 1.000 since the travel model will include all of these facilities. "Lower" classes (e.g. local roads) require greater adjustment since a large part of the local system is not under state jurisdiction and is not in the travel model. There is, of course, a significant amount of local road mileage in the state. It is assumed that those local streets that are in the travel model are representative of all local streets in their area with respect to volume and speed.

Figure 3: Decision Process for HPMS VMT Adjustments



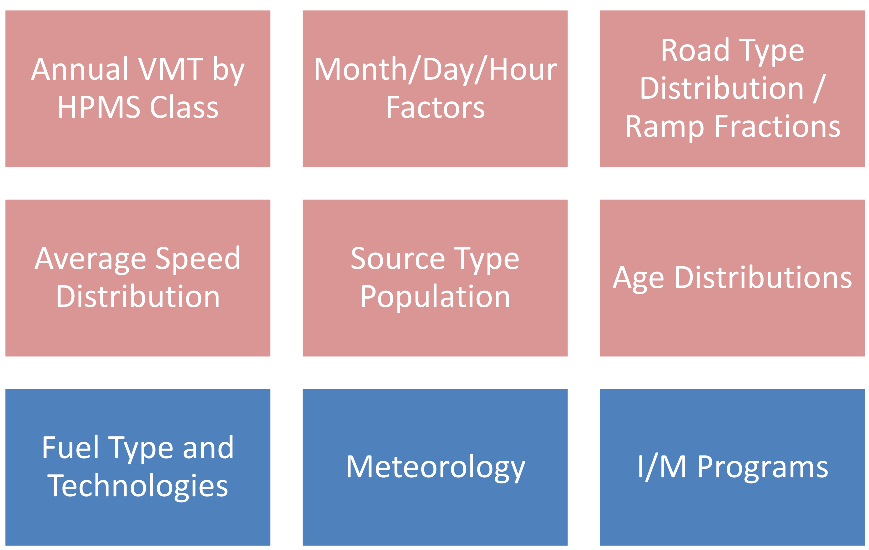
Additional decisions will be required to determine if the VMT adjustments should impact regional speeds. For example, if the model is under representing freeway VMT and/or project strategies are applied to affect regional VMT, then it may be assumed that such adjustments should have an impact on speed. If adjustments are simply to account for missing VMT, then speed adjustments may not be warranted. However, the recalculation of speeds may require additional post processing procedures as discussed in the following sections.

5.0 Recommendations for MOVES County Data Manager Inputs

MOVES includes a default national database of meteorology, vehicle fleet, vehicle activity, fuel, and emission control program data for every county; but EPA cannot certify that the default data is the most current or best available information for any specific area. As a result, local data is recommended for use for conformity analyses.

MOVES allows input of local data through its County Data Manager (CDM), an interface developed to simplify importing specific local data for a single county without requiring direct interaction with the underlying MySQL database. Use of the CDM is necessary when the scale is set to County and is required for SIPs and regional conformity analyses. Key inputs to the CDM are summarized in **Figure 4** and are addressed within this section with a specific concentration on the traffic-related inputs and vehicle age distributions.

Figure 4: Key MOVES CDM Inputs



EPA has developed tools and EXCEL convertor spreadsheets to help prepare the CDM inputs (www.epa.gov/otaq/models/moves/tools.htm). Many of these tools are focused on converting existing MOBILE6.2-formatted data into that needed by MOVES.

ADOT has developed custom spreadsheets to assist in converting the statewide model and state registration data into the input formats needed by the EPA convertor spreadsheets. A summary of ADOT's tools are summarized in **Table 6**. Data for I/M programs, alternative vehicles, meteorology and fuel parameters are either not currently used in ADOT's current sample process or utilize MOVES defaults.

In other regions, the EPA tools have been replaced by pre/post processing software or other custom EXCEL spreadsheets. Where possible, some regions have moved away from developing files using MOBILE6.2 formats, and instead directly creating the inputs for MOVES. The exception has been for vehicle age distributions, which are typically based on weight-based vehicle categories that better match with the MOBILE6.2 vehicle types. The following sections describe key issues and recommendations related to the preparation of CDM inputs.

Table 6: ADOT Custom Spreadsheet Tools

MOVES Input	ADOT Tool (EXCEL)	EPA Converter (EXCEL)	MOVES CDM File
Vehicle Population	MVD Registration Converter		SourceTypeYear
– Age Distribution – VMT by HPMS Vehicle Type – VMT Fraction – Road Type Distribution	– Daily VMT Converter – Hourly VMT Converter – Mobile6 Reg Distribution Calculator	vmt-converter-road-veh16	SourceTypeAgeDistribution HourVMTFraction RoadTypeDistribution
		aadvmtcalculator_hpms	HPMSvTypeYear DayVMTFraction MonthVMTFraction
Ramp Fraction	HPMS Ramp Fraction Calculator	vmt-converter-road-veh16	RoadType RampFraction
Speed Distribution	Speed Calculator	averagespeedconverter_mobile6_weekdays	AvgSpeedDistribution

5.1 Annual VMT by HPMS Class

EPA expects users to develop local VMT estimates for SIPs and regional conformity analyses. The data sources discussed in **Section 4** will likely serve as the primary source of that information in Arizona. MOVES requires annual VMT by six HPMS vehicle classes. Within MOVES these vehicle classes are disaggregated to 13 source types. Per information received from EPA's OTAQ, the relationship between the HPMS vehicle classes and MOVES source types is described in **Table 7**. These definitions are also important in mapping vehicle classes to registration data for the vehicle population and fleet age inputs as discussed in later sections.

The preparation of the MOVES VMT input file will include two primary steps: annualization of model results and disaggregation to vehicle classes. The annualization of travel model VMT will most likely depend on the seasonal and daily factors input to MOVES. This will require identifying what type of day is represented by the travel model results (e.g. annual average daily traffic (AADT), an average annual weekday (AWDT), or a specific weekday in a month). EPA provides an EXCEL tool to help compile daily VMT and seasonal/daily factors into the formats required by MOVES.

Table 7: Description of MOVES Vehicle Categories

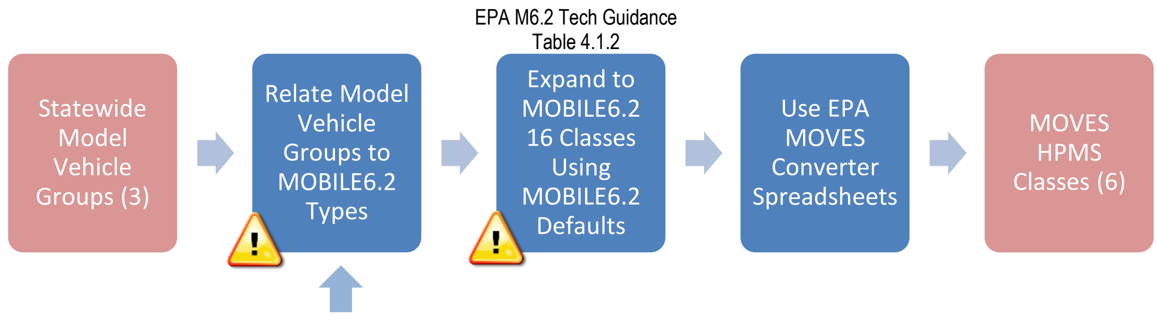
Source Type ID	Source Use Type	Description	HPMS Vehicle Class
11	Motorcycle	Vehicles with less than four wheels.	**Motorcycle**
21	Passenger Car	Four wheel, two axle vehicles whose primary function is passenger transport.	**Passenger Car**
31	Passenger Truck	Four wheel, two axle trucks whose primary functional design is for cargo, but are used primarily for passenger transport.	**Light Trucks**
32	Light Commercial Truck	Four wheel, two axle trucks used primarily for cargo transport.	
41	Intercity Bus	Passenger vehicles with a capacity of 15 or more persons primarily used for transport between cities.	**Buses**
42	Transit Bus	Passenger vehicles with a capacity of 15 or more persons primarily used for transport within cities.	
43	School Bus	Passenger vehicles with a capacity of 15 or more persons used primarily for transport of students for school.	
51	Refuse Truck	Trucks primarily used to haul refuse to a central location.	**Single Unit Trucks**
52	Single Unit Short-haul Truck	Single unit trucks with more than four tires with a range of operation of up to 200 miles.	
53	Single Unit Long-haul Truck	Single unit trucks with more than four tires with a range of operation of over 200 miles.	
54	Motor Home	Trucks whose primary functional design is to provide sleeping quarters.	
61	Combination Short-haul Truck	Combination tractor/trailer trucks with more than four tires with a range of operation of up to 200 miles.	**Combination Trucks**
62	Combination Long-haul Truck	Combination tractor/trailer trucks with more than four tires with a range of operation of over 200 miles.	

The disaggregation of travel model vehicle groups to the six HPMS classes is an important step that may include a combination of local and national data. For the ADOT statewide travel demand model, traffic volumes are produced for three vehicle groupings:

- Auto
- Single-unit trucks (SUT)
- Multi-unit trucks (MUT)

Figure 5 illustrates the sample EXCEL-based process for Pinal County ("*ADOT Daily VMT Calculator for Pinal.xls*"). In that process, EPA's converter spreadsheets are used to convert MOBILE6.2-based data into the formats needed by MOVES.

Figure 5: Existing Sample Pinal Process for Vehicle Disaggregation



Mapping of Statewide Model Vehicle Types to MOBILE6.2 Classes

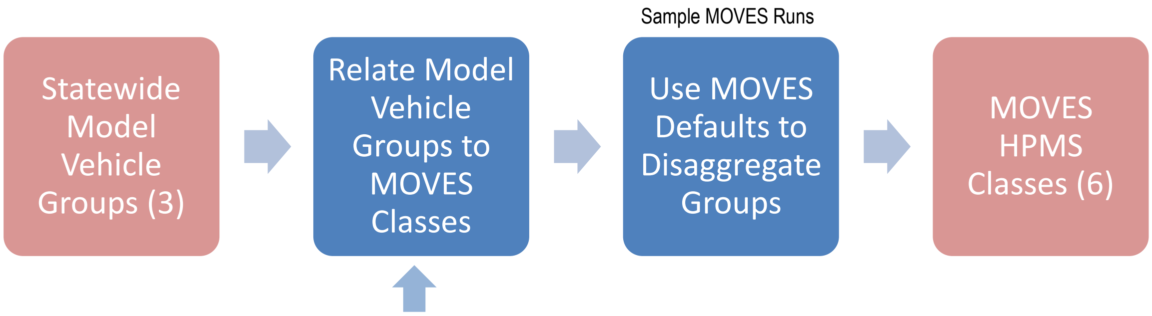
Statewide Model	MOBILE6.2 Types
Auto	LDV
SUT	LDT1-4
MUT	HDV2-HDV8B
HDBS, HDBT (Assumed 0 for Pinal)	
MC (Used National Default)	

Several concerns have been identified with the sample vehicle mapping approach. These concerns are summarized as follows:

- The mapping of statewide model vehicle groups to the MOBILE6.2 weight-based classes may require additional review and/or assessment. In MOBLE6.2, the light-duty trucks (LDT1-4) include many of the sport utility vehicles (SUVs) being used for passenger travel. It is expected that the statewide travel model's "auto" category actually includes a large percentage of these vehicles. If that is the case, then the SUT model category most likely includes heavier trucks in the HDV2-HDDV7 range.
- Table 4.1.2 from EPA's MOBILE6.2 technical guidance provides the national distribution of VMT by the MOBILE6.2 16 weight-based vehicle types. This data is based on 1999-2002 information and forecasted trends developed by EPA at that time. There are several concerns with using this information for future studies. The late 1990's included a significant growth in SUV vehicles (LDT1-4). As can be seen in Table 4.1.2 (of the guidance), EPA continued this growth out to 2020. These forecasted growth trends are not representative of recent trends. With higher gas prices, large SUVs have decreased significantly and cars and light trucks have become of lighter weight to improve fuel economy. As a result, it is not recommended to utilize Table 4.1.2 from EPA's MOBILE6.2 technical guidance.

Many areas have worked to move away from using MOBILE6.2 and EPA's converter spreadsheets in preparing the MOVES VMT input file. In these cases, mapping the vehicle groups directly to the MOVES HPMS vehicle classes will be necessary using the information as shown in **Table 7**. This recommended process is illustrated in **Figure 6** and can be adjusted based on more specific information on the types of vehicles included in each travel model vehicle group.

Figure 6: Recommended Process for Vehicle Disaggregation



Potential Mapping of Statewide Model Vehicle Types to MOVES HPMS Classes

Statewide Model	MOVES Classes
Auto	Passenger Car
	Motorcycle
	(x%) of Light Trucks
SUT	(x%) of Light Trucks
	Single Unit Trucks
	Buses
MUT	Combination Trucks

Disaggregating the statewide model Auto and SUT vehicle groups to the MOVES classes can be supported by MOVES default runs to identify the percentage distribution among vehicle types. In addition, other states (e.g. Pennsylvania and Maryland) have developed mapping schemes that utilize information from the National Transit Database (NTD) and school bus registrations to better identify the portion of VMT related to those vehicle classes.

5.2 Month/Day/Hour Fractions

MOVES emission rates vary by month, day (weekday vs. weekend) and hour due to variations relating to environmental data (e.g. temperatures, humidity) fuel characteristics, and the number of starts assumed per day. The MOVES CDM files can be indexed as follows:

- Month – by vehicle class
- Day – by vehicle class and road type
- Hour – by vehicle class and road type

States and MPOs typically either develop these fractions based on available traffic count data or using MOVES national defaults. State DOT permanent count locations used to support the HPMS are often the primary data source for the development of these adjustments. In Pennsylvania and Maryland, the factors are extracted from an annual report prepared by the DOT documenting the results of the traffic count data system.

Sample MOVES CDM inputs for Pinal County do not provide the monthly and daily factors so it is assumed that the national defaults are currently being used. These defaults are provided within several of EPA's Excel MOVES data preparation tools. In many areas, local data appears reasonably consistent with national averages. If a specific county has unique travel characteristics by season or between weekdays and weekends, then it may be recommended that local count data be used as input to MOVES instead of the national defaults.

ADOT has developed hourly pattern files based on information from the statewide model. The current approach represents an acceptable methodology that has been used in other custom post processing software. The approach utilizes the fraction of total VMT for each time period (AM, midday, PM, and night) and the national hourly default fractions. For each time period the national hourly data is normalized to the model results. These results are then developed in MOBILE6.2 format and input to the EPA converter spreadsheets to prepare the MOVES CDM inputs. More robust methods may be considered to account for potential differences by each MOVES road type. The PPSUITE post processing software (as used in areas within the northeast) contains methodologies to estimate an aggregate hourly fraction file based on variances by functional class or even link. The post processor combines the information to develop a composite average for all the links with a common MOVES road type value.

5.3 Road Type Distribution/Ramp Fractions

The fraction of VMT by road type varies from area to area and can have a significant effect on overall emissions from on-road mobile sources. EPA expects states to develop and use their own specific estimates of VMT by road type and have provided tools to assist in developing the CDM inputs.

As is the case for other MOVES inputs, EPA does not expect that users will be able to develop local road type distributions for all 13 vehicle source types. If local road type distribution information is not available for some source types, states can use the same road type distribution for all source types within an HPMS vehicle class.

The sample processing for Pinal County utilizes travel model outputs by vehicle type and functional class to develop a roadway type distribution. This meets and exceeds EPA's recommendations and is consistent with methods used by other states. As done for other CDM inputs, some states have focused on automating the production of these files based on the travel model outputs.

Ramp fractions is an optional MOVES CDM input file. A default of 8% of the total vehicle hours of travel (VHT) will be used if local data is not available. The ADOT statewide model does have ramp facilities coded allowing for a direct computation of the ramp fractions by road type. However, if there are concerns over the model's ability to produce accurate ramp volumes, then the use of defaults may be warranted. It should be noted and stressed that the ramp fractions are determined based on VHT, not VMT. This is a difference from the MOBILE6.2 ramp fraction inputs. As a result, additional computations may be required to determine appropriate values by VHT using both the VMT and speeds for each facility.

5.4 Travel Speeds

Emissions for many pollutants (including VOC, NOx and PM) vary significantly with travel speed. The variance of $PM_{2.5}$ (similar trends for PM_{10}) emissions was illustrated earlier in this document in **Figure 1**. MOVES allows users to provide a distribution of vehicle hours of travel (VHT) by 16 speed bins, by each road type, source type, and hour of the day. The bins relate to ranges of average driving speed. EPA also allows modification of more detailed drive cycles and operating mode distributions; however, such changes are primarily used for project-level analyses where detailed simulation or test drive data are available.

> From Section 3.6 of EPA's Technical Guidance:
> (http://www.epa.gov/oms/models/moves/420b10023.pdf)
>
> Selection of vehicle speeds is a complex process. The recommended approach for estimating average speeds is to post-process the output from a local travel demand network model. In most transportation models, speed is estimated primarily to allocate travel across the roadway network. Speed is used as a measure of impedance to travel rather than as a prediction of accurate travel times. For this reason, speed results from most travel demand models must be adjusted to properly estimate actual average speeds.

For SIP and conformity analyses, EPA expects states to develop and use local estimates of average speed. Per their technical guidance, EPA recommends that this data be prepared at the most detailed level that is reasonable to obtain and that users develop speed distributions to represent vehicle speed, rather than one average value. Use of a distribution will give a more accurate estimate of emissions than use of a single average speed. These concepts provide the reasoning for more sophisticated post processing software used in other states. MAG's M6Link processor has been developed to process individual link speeds by time period and to prepare a speed distribution file for input to MOBILE6.2. These same concepts still apply to the MOVES application except for some slight differences in processing (MOVES requires distribution of VHT by speed bin, MOBILE6.2 requires distribution of VMT by speed bin). Other states and MPOs including those in Pennsylvania, Maryland, New Jersey, New York, and West Virginia have opted for more sophisticated post processing software that aims to perform the following functions:

- re-calculate congested speeds based on travel model volumes, roadway physical characteristics, and available free-flow speed data
- estimate impact of intersection control devices at a planning level of detail based on available signal location and intersection characteristics
- estimate congested speeds by hour of the day for input to MOVES
- preparation of MOVES speed-VHT distribution file

For regions with travel models, the need for speed post processing is often determined by the validity of the travel model speeds. MAG does not recalculate speeds from the travel model, but has conducted formal validation efforts of the regional speed data. However, speed validation has not been formally conducted for ADOT's statewide model where validation has focused primarily on the travel volumes produced by the model.

ADOT's sample process in Pinal County estimates the speed distribution file utilizing time period VMT and speed results from the statewide travel model. Individual link VMT and speeds are tabulated into each of the MOBILE6.2 speed bin categories. A final distribution is developed for each road type and hour combination using the link data. EPA's Excel converter spreadsheet is then used to develop the MOVES average speed distribution inputs by VHT (as required by MOVES). Although this process meets EPA's recommendations, there are several options to improve the sensitivity of the speed input parameters. These include:

- When assigning each link to a speed bin, the process can be enhanced to interpolate between two adjacent speed bins as to represent the exact value from the model. This process is illustrated in **Table 8**. This allows emission factors to be more sensitive to speed changes from the travel model.

Table 8: Example of Speed Bin Interpolation to Represent Link Speed

Travel Model Link Speed	MOBILE6.2 Speed Bin #	Speed Bin Description	% VMT Assigned to Each Bin
42	9	37.5 - 42.5 mph (40mph Midpoint)	60%
	10	42.5 - 47.5 mph (45mph Midpoint)	40%

- Areas with post processing software have developed methods to expand time period volumes to each hour of the day. In these cases, hourly speeds can then be determined and input to the MOVES model. The need for speed recalculation was discussed earlier in this section.

5.5 Vehicle Population Data

The information on the number of vehicles is a new input to MOVES (as compared to MOBILE6.2). The MOVES model requires the population of vehicles by the 13 source type categories, which are used to estimate the amount of start and evaporative emissions in the analysis region. According to EPA, the population data can be developed for many of these source types from state motor vehicle registration data, local transit agencies, school districts, bus companies, and refuse haulers.

If population data is not available for a particular source type, population data can be calculated based on the VMT estimates for that particular source type and the ratio of MOVES default population to VMT by source type. That ratio can be determined by doing a very simple MOVES run at the national scale for the county being analyzed, and including VMT and population in the output.

In Arizona, registration data is available for vehicle categories that are more consistent with the weight-based MOBILE6.2 vehicle types. The sample Pinal County analyses include the following steps:

- Convert registration data (for all vehicle classes) to MOBILE6.2 vehicle categories
- Use population mapping from Table A.1 of EPA MOVES technical guidance to convert to MOVES 13 source types

The above approach utilizes registration data for all vehicle types and follows methods approved by EPA.

Key Considerations for Preparing Vehicle Population:

- Does registration data adequately reflect the number of vehicles operating in the region on a daily basis?
- Are heavy trucks adequately represented in the registration database?
- Are there other data sources to improve mapping of vehicles to the MOVES 13 source types?

Other states including Pennsylvania have determined that their state registration data does not adequately represent the number of heavy trucks operating in some areas. This is due to a large number of trucks being registered in other states and the impacts of trucks traveling through the state from other regions. Likewise, similar evaluations may apply to an assessment of light-duty vehicles. Cities like New York and Washington, D.C. have determined that local registration data is not representative of the number of vehicles operating in their respective regions, since a large percentage of vehicles either come from neighboring counties or states, yet are contributing a significant amount of vehicle starts and evaporative emissions. However, adjustments to registration data are difficult to determine. Typically this involves comparing registration numbers to vehicle population numbers as calculated from available VMT (as described earlier in this section) and considering the number of starts and/or trips those vehicles are making. In New Jersey, investigations have been conducted to evaluate the use of travel demand model trip tables to determine the location and number of vehicle starts, but EPA does have some concerns on whether such models properly represent the number of actual trips in an area.

An evaluation must be conducted to determine whether registration data is appropriate for the MOVES emission analyses. In Pennsylvania, this has involved assessing alternative analysis options, testing the impacts of those options on emissions, and choosing the most conservative approach.

The mapping of registration data to MOVES sources types has primarily relied on EPA convertor spreadsheets (MOBILE6.2 to MOVES). Most states have registration data that more closely correspond to the MOBILE6.2 weight-based categories rather than the MOVES source types. Additional data sources can supplement the estimation of vehicle population for different MOVES sources types as discussed in the EPA technical guidance. Pennsylvania has used a separate download of school bus registrations by county, information from the National Transit Database (NTD), and other data from local transit operators to estimate the number of vehicles in each county. An adequate information source for refuse trucks and other bus companies has not been identified or used for MOVES application.

Forecasting the MOVES input source type population plays an important role in determining emissions for future years. The current conversion tools used for Pinal County do not address the growth of source type population. Other areas have forecasted the number of vehicles using:

- Household growth
- Population Growth
- Employment Growth
- VMT Growth

In Pennsylvania, the household, population and employment forecasts are obtained through a triennial purchase of Woods and Poole data. The growth rates for light-duty vehicles are calculated assuming the highest growth rate of household and population data but then limiting it to the VMT growth rate. Heavy vehicles have also considered the employment growth. This methodology has been used for past conformity analyses and has been accepted using the interagency consultation process.

5.6 Vehicle Ages

Vehicle age distributions are required as an input to MOVES for each county by the thirteen source types. The distributions reflect the percentage of vehicles in the fleet up to 31 years old. The vehicle age distributions can be prepared based on information from state vehicle registration database. For the sample Pinal County analyses, ADOT has utilized local registration data for all vehicle types.

Many of the issues in preparing vehicle age distributions are the same as those discussed in the previous section for vehicle population. This includes an assessment of whether state registration data for heavy trucks are representative of the actual trucks operating on the roadways. If this is determined to be an issue, then the potential use of national default data from the MOVES default database should be considered. In Pennsylvania, MOVES default ages for heavy trucks are used for all analysis runs.

Vehicle age distributions are considered one of the most significant items affecting regional emissions. Special considerations and review must be conducted when preparing and updating this data input.

Vehicle ages do have a significant impact on emission results and have been the source of a number of transportation conformity failures across the country. In most cases, this has been the result of updating vehicle age distributions for conformity as compared to existing SIP motor vehicle emission budgets. Since 2008, most areas have seen a substantial aging of the fleet. As a result, the recent use of newer data has increased mobile source emissions. Special review, test analyses, and considerations are required when determining what age data to use for:

- SIP emission inventories (especially those that will set new motor vehicle emission budgets, and
- transportation conformity forecast years to satisfy latest planning assumption requirements and to ensure that ages are representative of what may be expected over the next 10-20 years.

5.7 Other Data

Emission factors are impacted by other local input data including meteorology, fuel and control strategy assumptions. These assumptions are typically developed in close coordination with the state environmental agency (ADEQ).

EPA requires temperature data used for transportation conformity to be consistent with the SIP that contains applicable motor vehicle emission budgets.

The MOVES model requires temperature and relative humidity data for each hour of the day. The MOVES database includes default average monthly temperature and humidity data for every county. However, EPA does not recommend using these default values for conformity analyses. Detailed local meteorological data are available from the National Climatic Data Center which is recommended for conformity purposes. EPA's data converters are used to convert minimum and maximum daily temperatures to an hourly temperature profile that could be input to MOVES. Note that conformity requirements do specify that temperatures and humidity must be consistent with those used for any SIPs that establish motor vehicle emission budgets (MVEBs).

The MOVES default database has fuel formulation and fuel supply data which are to be reviewed and updated based on available local volumetric fuel property information. However, in the case of RVP, the default value should be changed to reflect the regulatory requirements and differences between ethanol- and non-ethanol blended gasoline. In other states, there have been some discussions with EPA in deciding on appropriate fuel assumptions for future analysis years including the appropriate content for ethanol mixes.

The MOVES model has simplified the I/M program input parameters compared to MOBILE6.2. The default I/M program parameters included in MOVES need to be examined and necessary changes are to be made to the defaults to match the actual local program. In particular, users should note that any grace periods or exemptions ages need to be included in the beginning and ending model years based on the calendar year of evaluation. The default I/M files do not incorporate grace periods or exemption ages.

5.8 Summary Evaluation of Current Practices for Pinal County

The previous sections have discussed the key inputs to MOVES CDM. **Table 9** summarizes the key issues and recommendations for each of the inputs based on the review of the sample Pinal County files.

Table 9: Summary of Key Recommendations Regarding MOVES CDM Input Data

MOVES CDM Input Data	Existing Process Review (Pinal) Issues/Considerations	Options for Process Modification/Enhancement
Annual VMT	• Ensure method to account for missing VMT and HPMS reconciliation • Re-evaluate mapping of travel model vehicle types to MOBILE6.2 classes (e.g. Auto and SUT categories) • Use of MOBILE6.2 national default distributions by type is outdated especially for determining light truck percentages	• Consider direct conversion from travel model vehicle types to MOVES HPMS vehicle class • Use MOVES defaults to disaggregate data since based on newer information. • Integration of other data sources for transit and other vehicle types.
Month/Day/Hour Fractions	• Evaluate if Monthly/Daily default data is representative of analysis region.	• Develop separate hourly pattern data by MOVES road type using travel model results
Road Type Distribution		
Ramp Fractions	• Evaluate if ramp VMT is reasonable from travel model. May consider using defaults if any issues. • Ensure that fractions are based on VHT not VMT	
Travel Speeds	• Are travel model speeds acceptable for air quality analysis? Is post processing required?	• Speed post processing to obtain better speed estimates with possible inclusion of intersection delay. • Enhance computation of average speed distribution by interpolating between multiple speed bins to represent individual link speeds • Estimate speeds by hour of day
Vehicle Population	• Evaluate methods to forecast vehicle population • Evaluate if state registration data is representative of heavy vehicle population	• Enhanced methods for forecasting. • Investigate alternative methods for estimating heavy vehicle population for SIPs including calculation from heavy vehicle VMT
Vehicle Ages	• Evaluate if state registration data is representative of heavy vehicle population	• Considerations for further investigation in developing ages for conformity based on recent trends.
Fuel Parameters / IM	• Evaluate assumptions for future forecast years with EPA including ethanol percentage.	
Temperature Humidity	• Must be consistent with SIP.	

6.0 Recommendations for MOVES Operation

This section addresses several key issues related to the operation of the MOVES emission model. For SIP and transportation conformity analyses, MOVES must be run using the software's "County" scale. Under that mode, specific county data is provided through a County Data Manager (CDM) input interface. A discussion of the specific county inputs is provided in **Section 5.0**. This section focuses on evaluating the operation of MOVES in the "inventory" vs. "rate" modes and the potential role of batch processing and custom pre/post processing software.

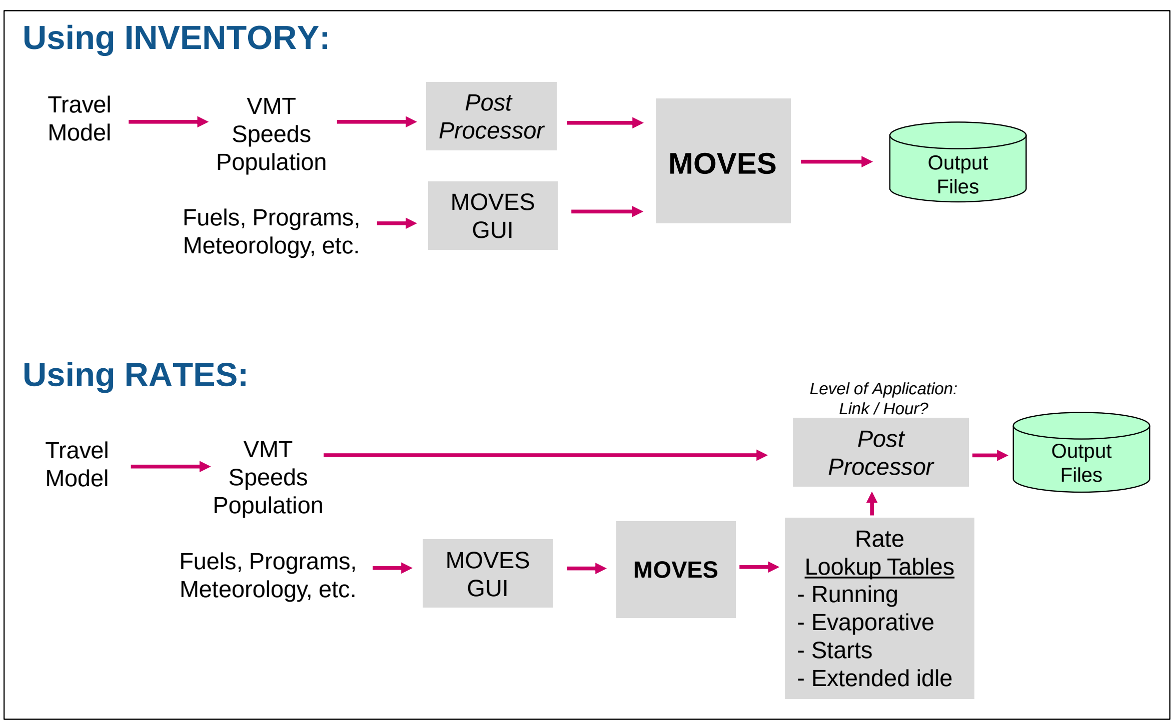
6.1 Identifying Method to Run MOVES (Inventory vs. Rate)

MOVES offers two run mode options for calculation emissions:

- Inventory Mode
- Rate Mode

As illustrated in **Figure 7**, the choice of the above modes will affect the design and methods for batch processing and the selection of post processing methodologies and tools. With an inventory approach, users input VMT and vehicle population data into MOVES and the model outputs emissions (in units of mass). With the emission rates approach, users apply VMT and vehicle population to the emission rates that MOVES generates to calculate an inventory (although VMT and vehicle population data are still needed as inputs for a MOVES emission rates run). The emission rates approach produces a look-up table of emission rates (as mass per unit of activity) that must be post-processed to produce an inventory.

Figure 7: MOVES Inventory vs. Rate Methods



Users may select either the inventory or emission rates approach to develop emissions estimates for SIPs and regional conformity analyses. Each approach has advantages and limitations and users will need to decide which approach is more appropriate for the type of analysis that is being conducted and available post processing tools. Both approaches use the same underlying emissions data and will produce, essentially, the same results if the user calculates an inventory from rates in the same way that MOVES peforms this internally.

When modeling a single time and place, the inventory method may be preferable since the emission rate calculations in MOVES are significantly more time consuming. Also, the post-processing steps required can be minimized with the inventory method, thus avoiding inadvertent errors during the application of rates. The emission rates method may be preferable for large scale projects, to obtain a lookup table of rates that can be applied to many times and places, thereby reducing total MOVES run time. Successful application of this approach requires a clear understanding of the rates calculations in MOVES and careful planning.

EPA recommends that the same approach be used in any analysis that compares two or more cases (e.g., the base year and attainment year in a SIP analysis or the SIP budget and the regional conformity analysis). The interagency consultation process should be used to agree upon a common approach. If different approaches are used for the SIP budget and the regional conformity analysis for practical reasons, the interagency consultation process should be used to determine how to address (and minimize) any differences in results. The methods, and those methods used to develop inventories should be fully documented in the regulatory submittal and conformity determinations.

In Pennsylvania, Maryland and New Jersey both methods have been investigated for conformity application. Each of these states have chosen the inventory method due to its more reasonable run times and simpler application. It also provides a cleaner framework for EPA review. However, the use of emission rates remains an alternative option for other emission calculation activities. In each of these states, MOVES rate tables are being used to support off-model analysis tools to evaluate the emission impacts of various strategy types. In these cases, detailed rate tables by model year, vehicle type, and speed bin are produced for each analysis year. Custom software has been designed to utilize these rates to produce strategy emission results. Other areas, including the Indianapolis MPO have designed custom post processing software to apply MOVES emission rates to the traffic data produced from the travel model. These efforts require upfront time to create the lookup tables and to design software to apply those rates but provide efficient run times for future applications of the conformity runs. For application in Arizona, the choice of methods will ultimately be influenced by available software and methodology tools. It is recommended initially that the MOVES inventory method be used for emission computations in support of regional conformity analyses. The development and application of a rate-based process creates additional complexities requiring more upfront resources. As EPA integrates future emission standards and releases MOVES2013, rate tables would require frequent updates.

Recommendation for Arizona Conformity Analyses:

- Prepare county inputs to MOVES.
- Run MOVES using the inventory mode
- Summarize MOVES output emissions

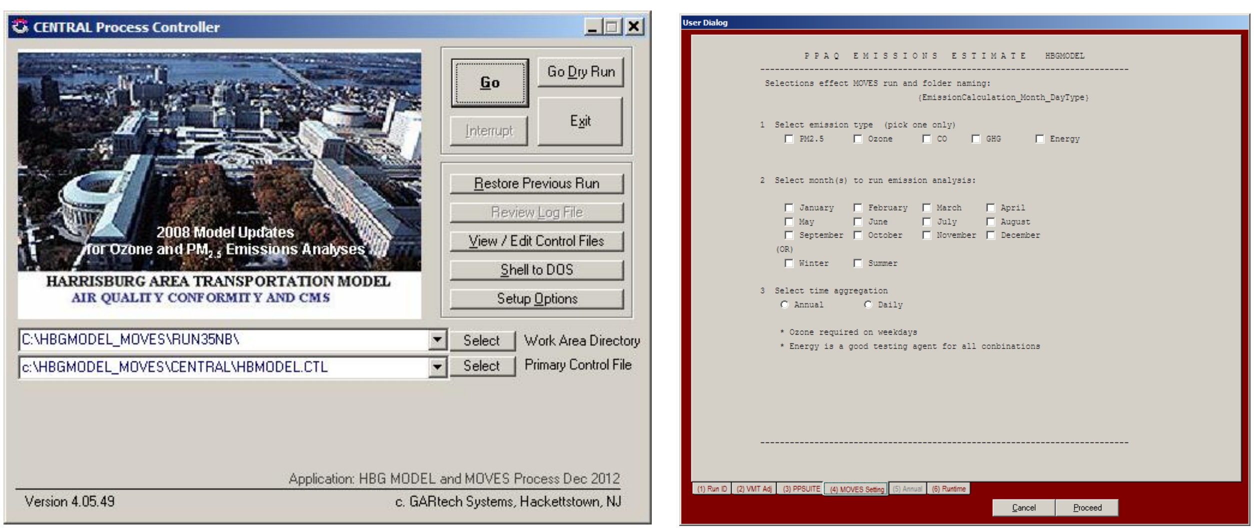
6.2 Batch Processing

One of the enhancements of MOVES over MOBILE6.2 is the inclusion of a graphical user interface (GUI). The GUI allows users to select key run options, provide county input data, and select output database names. The GUI does allow users to more easily modify the key input parameters and data needed to make an analysis run. However, many regions have looked to integrate the MOVES model with other travel modeling procedures and have focused on running the MOVES model in batch mode.

The focus on batch processing (i.e. allowing for many runs to be conducted concurrently without using the MOVES interface) has been a key feature that allows agencies to efficiently complete emission inventories. Such processing can be integrated with other quality control features, file naming conventions, and other calculation processing including that for re-entrained road dust.

In Pennsylvania, New Jersey, Maryland and Louisiana, MOVES has been integrated with custom pre/post processing software. In each of those areas, the running of MOVES is handled as part of a consolidated batch process. In these cases, MOVES driver files (for both the main program [.mrs] and the county data manager [.xml] are created during the run based on parameters provided in defined menu screens. **Figure 8** illustrates the use of the CENTRAL batch software, which has been used by a number of MPOs and states.

Figure 8: Example of Specialized Software to Control Emission Processes



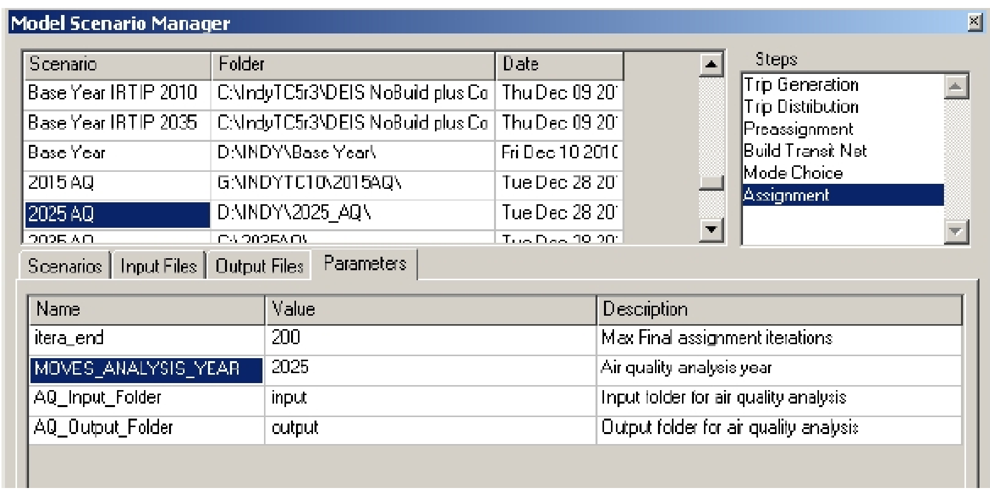
CENTRAL is a PC-based program which runs within the standard Windows environment. It manages multi-step jobs which can include elements of traffic modeling software (e.g. TransCAD, Cube Voyager), xBase, EXCEL, air quality software (MOVES, MOBILE6.2), as well as user-specified and supplied DOS and Windows programs. CENTRAL provides three primary components:

- The <u>Central Interface</u> provides control and management over the preparation, running, and review of the job. It is customizable with user-prepared graphics and user dialogs so that a unique look and feel can be presented to a model end-user.

- The Batch Processor provides tools to assemble and process the job stream at execution time. Token substitution, file inclusion, logical switches, transparent program library references, and myriad other mechanisms allow the developer to essentially "program" and maintain the job stream.
- The User Dialog system allows the developer to set up the model's front end with Windows-like controls for data entry, file specification, check-offs and option buttons, and logical screen controls. The Dialog system is programmed in an intuitively obvious format within the job stream's control files; no special Windows programming skills are needed.

Other areas have accomplished batch processing directly through modeling software and other computer programming languages. As illustrated in **Figure 9**, the Indianapolis MPO has utilized TransCAD's GISDK scripting language to provide an automated method to apply emission rate tables to the travel model assignments. GISDK provides tools that can be used to design menus and dialog boxes (including toolbars and toolboxes) and for writing macros.

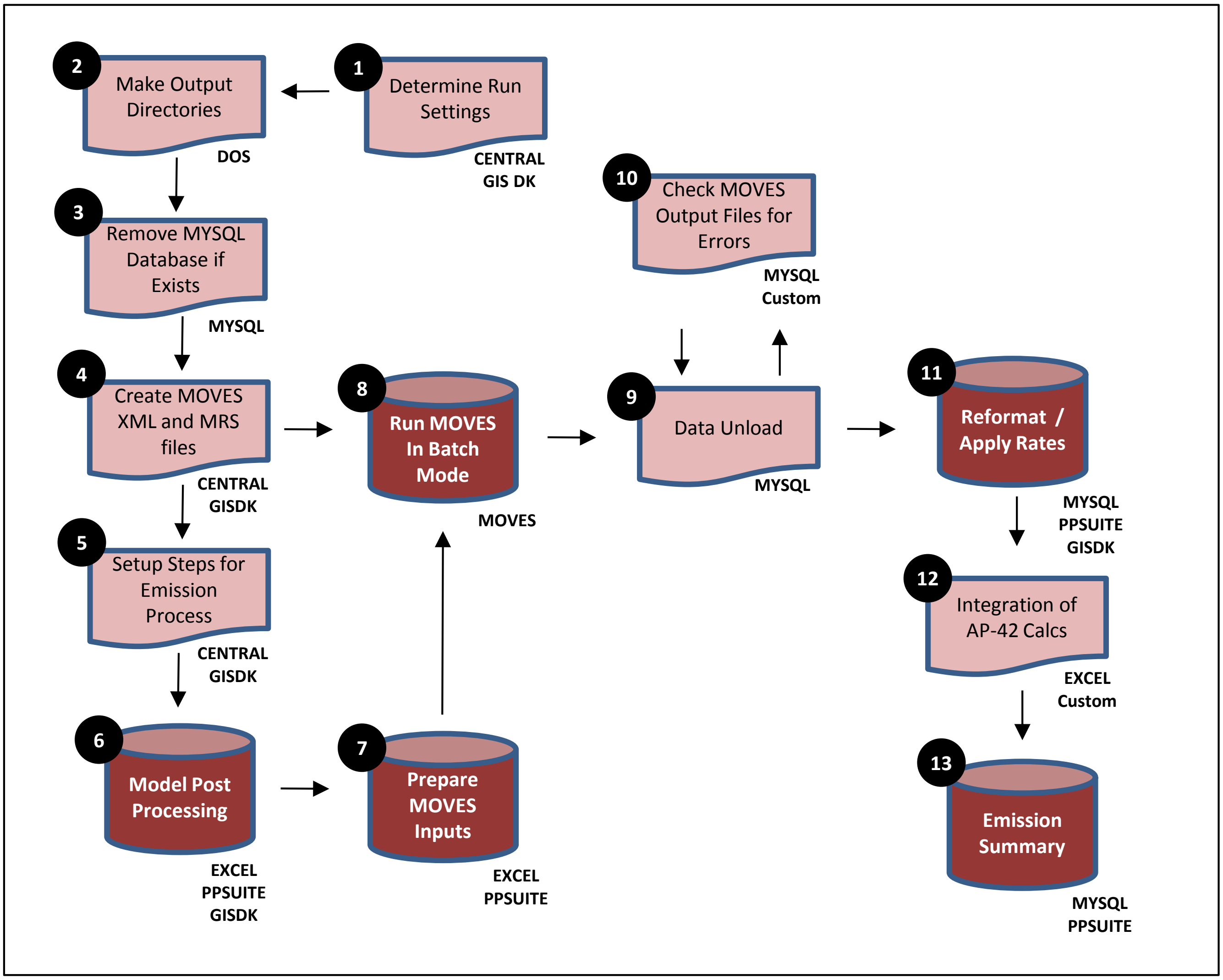
Figure 9: Use of GISDK to Support Air Quality Inventory Estimation



Although the above example illustrates the use of GISDK as a potential tool to conduct batch processing, the Indianapolis MPO process did not include the MOVES runs as part of the batch procedure. In this case, MOVES was run separately to produce the emission rate tables.

A batch process to support the running of MOVES can include a variety of steps and software. These steps may include processes for file management, quality control and pre/post processing of MOVES input and output files and integration of AP-42 re-entrained road dust calculations. Such steps may include use of the MYSQL data management software, simple DOS routines, custom software like CENTRAL, and pre or post processing software (e.g. GISDK, PPSUITE as described in more detail in **Section 6.3**, and EXCEL spreadsheets and/or macros). **Figure 10** illustrates the key steps of a potential batch process illustrating the potential linkages of multiple steps and programs.

Figure 10: Sample Steps for MOVES Batch Processing



In Arizona, re-entrained road dust calculations using AP-42 must be integrated with the MOVES emission results to produce total emissions for PM. Batch processing methods can be used to integrate these calculations as part of an automated process. The MAG conformity process includes post processing software (M6link) to apply the AP-42 factors to the traffic data.

Batch processing has proven to be valuable in limiting file management errors and efficiently running analyses for multiple years and scenarios. As a result, it is recommended that software or custom routines be developed to support future transportation conformity and SIP emission calculations.

6.3 Integration of Pre-Post Processing Routines/Software

Pre and Post processing software/routines have been emphasized in previous sections and can play a key role in:

- batch processing,
- recalculating more accurate congested speeds from a regional travel model,
- applying VMT adjustments,
- mapping and disaggregating model vehicles types to the MOVES source types,
- developing the traffic inputs needed by the MOVES CDM, and
- summarizing MOVES output files.

Some of the above functions can be designed and customized using EXCEL spreadsheets. Several of ADOT's tools have already been created to help format and calculate the data needed for EPA's conversion tools. More sophisticated software has been used in other areas to improve efficiency and quality control and to provide enhanced methods for speed recalculation and disaggregation.

The following sections provide several examples of software and programs developed for other regions. The PPSUITE software has a flexible framework allowing its use for different regions. The NYMTC and Indianapolis processing tools are customized for their specific travel models but illustrate alternative methods for developing post processing routines.

➢ *Example1: PPSUITE*

PPSUITE is a custom post-processing software that has been designed to provide a flexible framework for linking regional travel demand model outputs to EPA's MOBILE6 and MOVES software, and for computing a variety of transportation system performance measures. PPSUITE consists of a set of programs that perform the following functions:

- Analyzes highway operating conditions.
- Calculates highway speeds.
- Compiles vehicle miles of travel (VMT) and vehicle type mix data.
- Prepares MOVES runs and processes MOVES outputs.

PPSUITE is a widely used and accepted tool for estimating speeds and processing emissions rates. It has been used for past SIP and conformity highway inventories in Maryland, Pennsylvania, New Jersey, New York City, West Virginia, and Louisiana. The software is based upon accepted transportation engineering methodologies. For example, PPSUITE utilizes speed and delay estimation procedures based on planning methods provided in the Highway Capacity Manual, a report prepared by the Transportation Research Board (TRB) summarizing current knowledge and analysis techniques for capacity and level-of-service analyses of the transportation system.

The PPSUITE process is integral to producing traffic-related input files to the MOVES emission model. **Figure 11** summarizes the key functions of PPSUITE within the emission calculation process. Other MOVES input files are prepared external to the PPSUITE software. These include vehicle population, vehicle age, environmental, and fuel input files. PPSUITE has been developed and maintained since the early 1990's. As a result, the software has been built and enhanced with a wide variety of options and flexibility. **Table 10** illustrates some of the key features.

PPSUITE is typically integrated with the CENTRAL batching software as described in **Section 5.** CENTRAL is a menu-driven software platform used to execute the PPSUITE and MOVES processes in batch mode. CENTRAL allows users to execute runs for a variety of input options and integrates custom MYSQL steps into the process. While the individual PPSUITE programs could be executed singly, from a simple DOS batch file or from another executive program, the CENTRAL system provides an open and maintainable method for controlling a PPSUITE run through a series of interactive dialogs.

Figure 11: PPSUITE Process and Sample Menu Screens

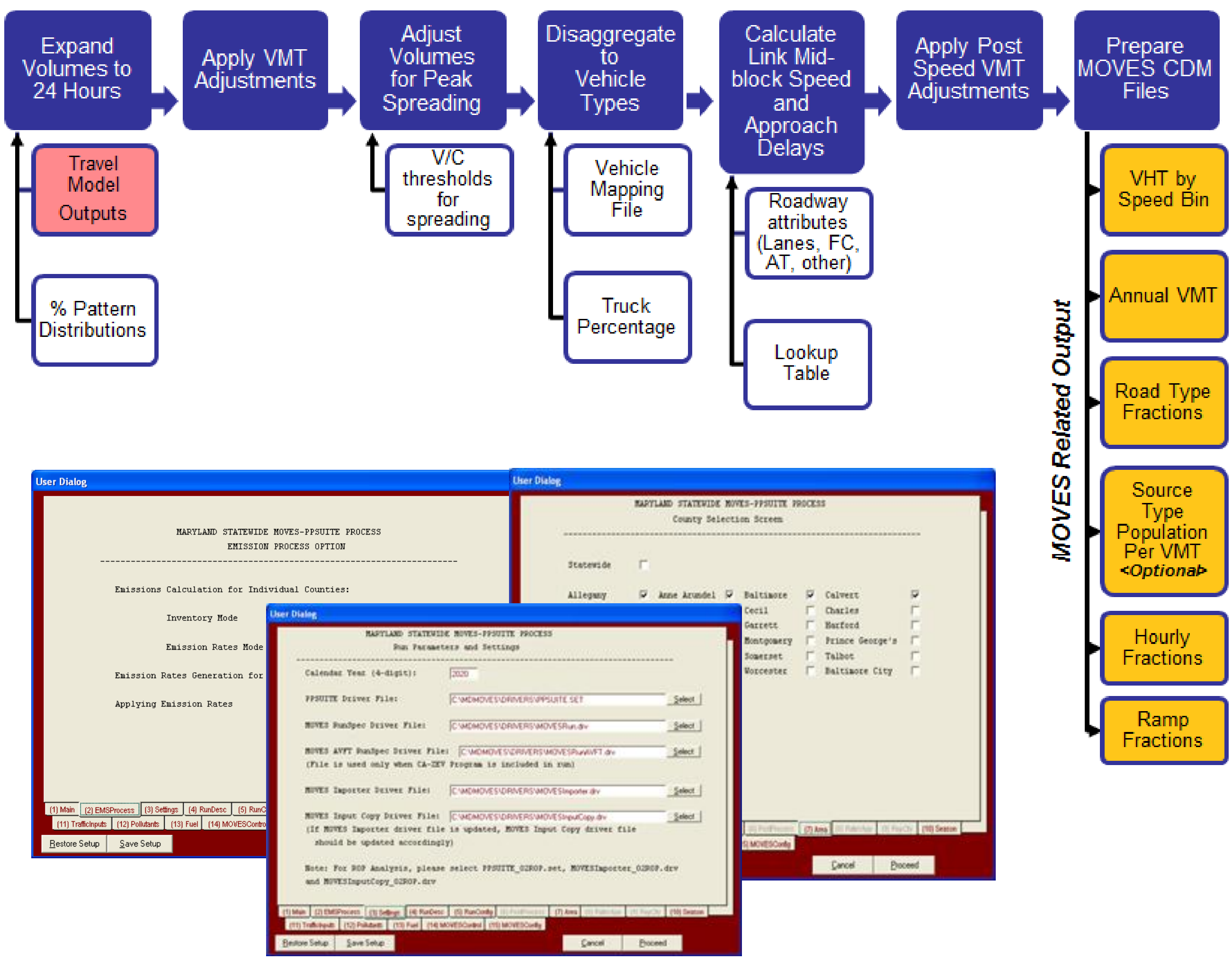


Table 10: Summary of PPSUITE Features

Category	PPSUITE Feature
VMT Adjustments	Applies up to 9 VMT adjustment files. o Can be applied as additive or factors. o Can be applied to daily total or to individual hours. o Can be applied before or after speed calculations.
Hourly Disaggregation of VMT	Disaggregate model volumes to individual hours to support emission calculations o Flexible to use available model time periods in combination with defined hourly patterns by functional class o Methods for peak spreading – can spread unreasonable hourly volumes to nearby hours as defined by user thresholds
Vehicle Type Disaggregation	Disaggregate model volumes to defined vehicle type categories o Can be based on a combination of model vehicle types and supplied input pattern files o Special features to handle mapping to MOVES source types
Speed Calculation	Flexible process to use travel model speeds or conduct speed re-calcuation o Speeds are calculated for each hour based on VMT disaggregation and VMT adjustments o Speed calculations based on available fields from travel model and/or a speed/capacity lookup table o Intersection delays can be synthesized using HCM planning methods o Roadway capacities are impacted by heavy vehicle percentages o A minimum speed or delay can be specified to prevent unreasonable speeds
MOVES Inputs	Automated creation of MOVES traffic input files for each scenario run o Creates a speed distribution file for each road type based on hourly speeds for each link o Creates the annual VMT file o Creates the road type distribution file based on supplied mapping scheme between model facility types and MOVES road type o Creates ramp fraction file if the ramp facility types are identified o Additional options for development of vehicle population file from supplied VMT (according to methods in EPA guidance)
MOVES Outputs	Extracts MOVES outputs to create an ASCII emission summary table o Can process results from a MOVES inventory run o Alternatively can take a supplied emission factor table from MOVES and apply the rates to VMT by source type.

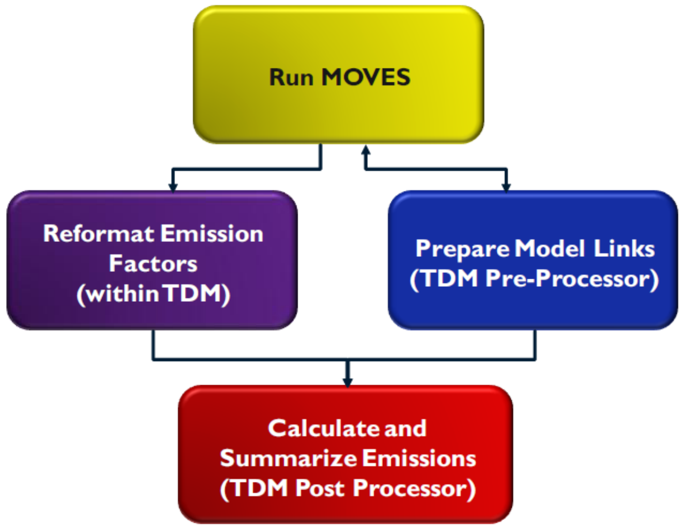
➢ *Example 2: TDM Post Processing for Indianapolis MPO (Custom GISDK)*

For the Indianapolis MPO, a custom processor for MOVES application has been linked to their regional TransCAD travel model. This example illustrates the use of Caliper's GISDK programming language in developing customized tools.

As illustrated in **Figure 12**, the processor does not control the running of MOVES; however, it does provide several traffic inputs to MOVES, which is run separately to generate emission factor tables. The processor extracts travel model information (e.g. VMT) and applies the MOVES emission rates to generate total emissions. The pre/post processor can be run from the MPO travel model interface by checking an "Air

Quality" option in the "Assignment" stage of the interface. The entire process takes approximately 10 to 15 minutes to run depending on the computer system's specifications.

Figure 12: Indianapolis MPO Emission Calculation Process



The pre-processor provides some inputs to MOVES, such as VMT and road type distribution. Once emission factors are generated from MOVES, the emission factors are reformatted in order to streamline the reading of the factors within the GISDK script and to get them in the format needed to apply to the travel activity data. The pre-processor prepares the travel activity data on the model links in order to apply the factors and then the post-processor calculates and summarizes both the running and non-running emissions.

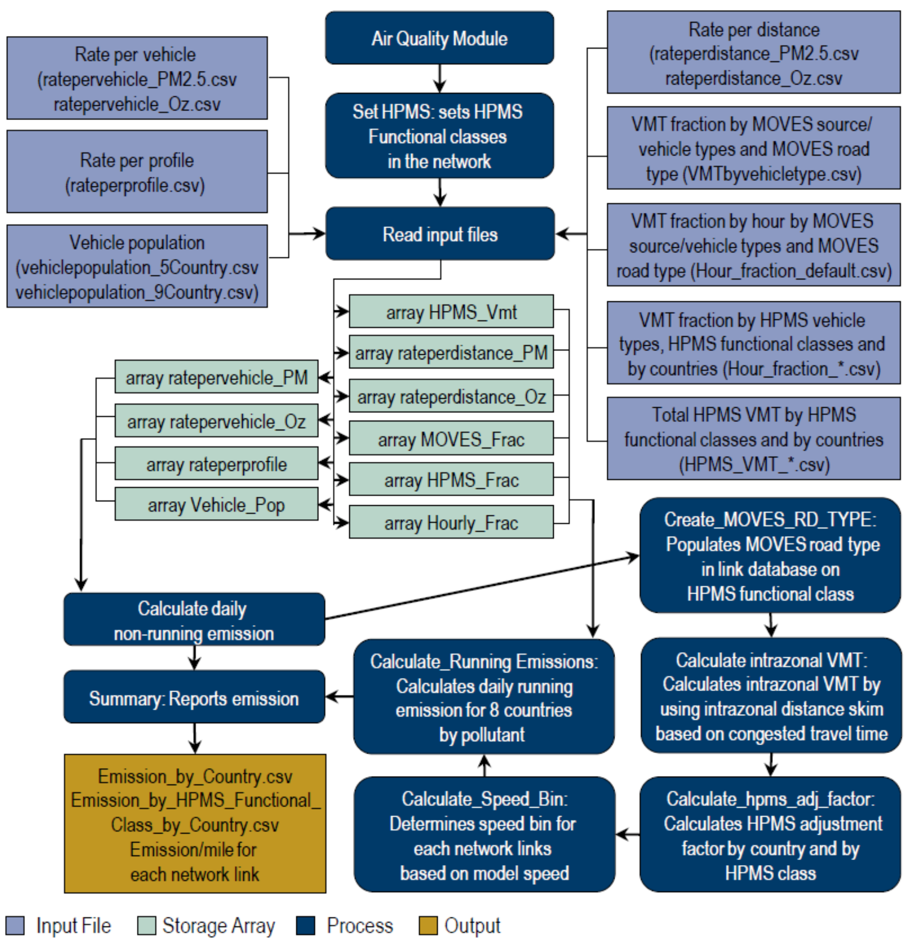
The air quality processing script was written in GISDK to make it compatible with the other components of the TransCAD model. The structure of the modules is illustrated in **Figure 13**. The air quality module consists of the following macros:

- *Set_HPMS*: Sets the HPMS functional class code in the line layer of the model network based on specified Facility Type and Area Type combinations on each link.
- *ReadFiles*: Reads the input files and stores the input data in arrays.
- *Calculate_NonRunning_Emissions*: Calculates the daily non-running emissions based on emission rates generated by MOVES and the vehicle population within the MPO model boundary.
- *Create_MOVES_RD_TYPE*: Populates each network link with a MOVES road type code based on an HPMS functional class code equivalency table.
- *CalculateIntrazonalVMT*: Calculates intrazonal Vehicle Miles Traveled (VMT) based on intrazonal travel distance and intrazonal trips. The intrazonal VMT includes all travel activity that begins and

ends within the same traffic analysis zone and it is calculated for each time period and for both AB and BA directions.

- *Calculate_hpms_adj_factor*: Calculates adjustment factors based on the ratio of HPMS VMT to the model VMT. The adjustment factors are calculated for each of the HPMS functional class codes and for each of the nine counties. Based on previous interagency consultation discussions, HPMS adjustment factors are not currently used by the Indianapolis MPO and as such, these factors are set to 1.0.
- *Calculate_Speed_Bin*: Sets the speed bins for each network link based on congested model speeds for different times of day. It uses the five mile per hour (mph) speed bin ranges defined in MOVES to determine the speed bins for the network links.
- *Calculate_Running_Emissions*: This macro calculates the daily running emissions by applying the emission rates generated by MOVES to the weighted VMT. Summary: Summarizes the daily emissions by functional class and county.

Figure 13: Flow Diagram of GISDK Script for Air Quality Module



➢ *Example 3: NYMTC MOVES Post Processing Software*

The New York Metropolitan Transportation Council (NYMTC) has utilized the PPSUITE software for past conformity analyses. They are currently finalizing a new post processing system developed by Cornell University. This software was developed using the Microsoft .NET Framework with scripts written in the Python computer language. Several of the components still rely on PPSUITE software modules. The process and software is expected to be finalized in several months.

The post processing software focuses on linking NYMTC's travel model (referred to as BPM) to the MOVES emission model. A focus of emphasis as compared to previous tools has been to enhance the usage on servers allowing web-based control of process runs. Although the software was developed specifically for NYMTC, there may be opportunities for Cornell to transfer the framework to other areas in the future. Like PPSUITE, the software is made up of several key modules that perform similar functions. These include:

- *Scenario Manager* – Generates xml scripts to create MOVES input databases, MOVES Run Specification files, as well as scenario information. The module invokes execution of MOVES and uploads emission rate databases to the server.

- *PPS-Core* – Integrates emission rate databases and traffic-related information to calculate an emissions inventory.

- *PPS-PRELINK* – Prepares the appropriate traffic activity information. This includes methods to apply link-level adjustment procedures, post process link average speeds and adjust VMT with HPMS data.

- *PPS-ELINK* – Further disaggregates VMT data to the same resolution as the MOVES emission rate database. Calculates an emissions inventory for link-based emission processes (e.g. running, exhaust emissions)

- *PPS-EZONE* – Calculates a total start and evaporative emission inventory. Distributes the emissions inventory to different road types, proportional to the VMT on each road type.

- *PPS-EPOST* – Integrates link level and zone level emission inventories. Incorporates off-model VMT adjustment factors for each county and road type.

Recommendation

To assist with the integration of MOVES and to support the batch processing options discussed in Section 6.2, a customized pre/post processing system is recommended for integrating ADOT's statewide model to the MOVES emission calculation process. As an example process, a case study will be conducted utilizing the PPSUITE software.

7.0 PM Emissions from Re-entrained Road Dust

In Arizona, re-entrained road dust is a significant component of PM_{10} mobile source inventories and is required to be included in all conformity analyses of direct PM_{10} emissions, including hot-spot analyses [refer to the March 2006 Final Rule (40 CFR 93.116) and (71 FR 12496-98)].

MOVES does not estimate emissions of re-entrained road dust. Therefore, re-entrained road dust emissions must be calculated using the empirical equations found in AP-42, Chapter 13, *Miscellaneous Sources*. Variables to calculate road dust emissions included VMT, average vehicle weight, AP-42 silt loading factors and particle size coefficients, and precipitation data.

7.1 Paved Roads

Paved road dust is fugitive dust that is deposited on a paved roadway and then re-entrained into the air by passing vehicles. Dust is deposited on the roadway by being blown from disturbed areas, tracked from unpaved shoulders or vehicles traveling on connecting unpaved roads, stirred up from unpaved shoulders by wind currents created from traffic movement, spilled by haul trucks, and deposited by water runoff or erosion. Vehicles cause dust from paved and unpaved roads to be re-entrained or re-suspended in the atmosphere. The forces created by the rolling wheels of vehicles remove fine particles from the road bed and also pulverize aggregates lying on the surface. Re-entrained road dust emission rates are primarily affected by the silt loading on the road and amount of vehicle travel. Emission rates are lower per mile traveled on more trafficked roads.[1]

Using AP-42 for Road Dust on Paved Roads

Section 13.2.1 of AP-42 provides a method for estimating emissions of re-entrained road dust from paved roads for situations for which silt loading, mean vehicle weight, and mean vehicle speeds on paved roads fall within ranges given in AP-42, Section 13.2.1.3 and with reasonably free-flowing traffic. Section 13.2.1 of AP-42 contains predictive emission factor equations that can be used to estimate an emission factor for road dust.

When estimating emissions of re-entrained road dust from paved roads, site-specific silt loading data must be consistent with the data used for the project's county in the regional emissions analysis (40 CFR 93.123[c][3]). In addition, if the project is located in an area where anti-skid abrasives for snow-ice removal are applied, information about their use should be included (e.g., the number of times such anti-skid abrasives are applied).

[1] United States Environmental Protection Agency, *EPA's Technical Support Document for the San Joaquin Valley, California, 2003 PM_{10} Plan and 2003 PM_{10} Plan Amendments*, January 27, 2004.

For the paved roadway improvements the calculation begins with the calculation of the base emissions on the roadway from re-entrained dust:

Emissions Factor is E_{ext} = [k (sL)0.91 x (W)1.02] (1 – P/4N)

Annual Emissions Reduction = Roadway VMT_{Annual} * E_{ext}

Where:

Eext = annual or other long-term average emission factor in the same units as *k,*

k = particle size multiplier for particle size range and units of interest – AP-42 Recommends a value of 1.00 g/VMT for PM_{10}

sL = road surface silt loading (grams per square meter) g/m^2 – supporting documentation recommends a value of 3.8 g/m^2 for Arizona

W = average weight (tons) of the vehicles traveling the road

P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period

N = number of days in the averaging period (e.g., 365 for annual)

7.2 Unpaved Roads

When a vehicle travels on an unpaved surface, such as an unpaved road or unpaved parking lot, the force of the wheels on the road surface causes pulverization of surface material. The dust is suspended by the turbulent vehicle wakes and ejected into the air by the shearing force of the tires. The quantity of dust emissions from a given segment of unpaved road varies linearly with the volume and speed of traffic. Field investigations also have shown that emissions depend on source parameters that characterize the condition of a particular road and the associated vehicle traffic. Characterization of these source parameters allow for the adjustment of emission estimates based on specific road and traffic conditions present on public and industrial roadways.

Using AP-42 for Road Dust on Unpaved Roads

Section 13.2.2 of AP-42 provides a method for estimating emissions of re-entrained road dust from unpaved roads. Different equations are provided for vehicles traveling unpaved surfaces at industrial sites and vehicles traveling on publicly accessible roads. Most PM hot-spot analyses will involve only vehicles traveling on publicly accessible roads. When applying an equation that accounts for surface material moisture content, the percentage of surface material moisture must be consistent with the data used for the project's county in the regional emissions analysis (40 CFR 93.123[c][3]).

AP-42 provides the following formulations for calculating emissions on an unpaved roadway depending on the nature of the road.

For vehicles traveling on unpaved surfaces, emissions are estimated from the following equations:

Industrial Sites: $E = k\,(s/12)^a (w/3)^b * 281.9$ **g/VKT**

Public Roads: $E = k(s/12)^a * 281.9$ **g/VKT**
(Assumed Primarily Light-Duty Vehicles)

Where:

E = size-specific emission factor (lb/VMT)

k, a and **b** are constants. For PM_{10} the values are:

k = 1.5 (lb/VMT)

a = 0.9

b = 0.45

s = surface material silt content (%) – see **Table 11** below

w = mean vehicle weight (tons)

Table 11: Typical Silt Content Values of Surface Material for Unpaved Roads (from AP-42)

Industry	Road Use or Surface Material	Plant Sites	No. of Samples	Silt Content Range	Silt Content Mean
Copper smelting	Plant road	1	3	16 – 19	17
Iron and steel production	Plant road	19	135	0.2 – 19	6.0
Sand and gravel processing	Plant road	1	3	4.1 – 6.0	4.8
	Material storage area	1	1	-	7.1
Stone quarrying and processing	Plant road	2	10	2.4 -16	10
	Haul road to-from pit	4	20	5.0 – 15	8.3
Taconite mining and processing	Service road	1	8	2.4 – 7.1	4.3
	Haul road to-from pit	1	12	3.9 – 9.7	5.8
Western surface coal mining	Haul road to-from pit	3	21	2.8 – 18	8.4
	Plant road	2	2	4.9 – 5.3	5.1
	Scraper Route	3	10	7.2 – 25	17
	Haul road (freshly graded)	2	5	18 – 29	24
Construction Sites	Scraper routes	7	20	0.56 – 23	8.5
Lumber sawmills	Log yards	2	2	4.8 – 12	8.4
Municipal solid waste landfills	Disposal routes	4	20	2.2 – 21	6.4

Source: United States Environmental Protection Agency, *AP-42 Chapter 13.2.2 Unpaved Roads*, January 2011.

7.3 Emissions from Construction-Related Activities

Emissions from construction-related activities are not required to be included in PM hotspot analyses if such emissions are considered temporary as defined in 40 CFR 93.123(c)(5) (i.e., emissions which occur only during the construction phase and last five years or less at any individual site). Construction emissions would include any direct PM emissions from construction-related dust and exhaust emissions from construction vehicles and equipment.

For most projects, construction emissions would not be included in $PM_{2.5}$ or PM_{10} hotspot analyses (because, in most cases, the construction phase is less than five years at any one site).[2] However, there may be limited cases where a large project is constructed over a longer time period, and non-temporary construction emissions must be included when an analysis year is chosen during project construction. Evaluating and choosing models and associated methods and assumptions for quantifying construction-related emissions must be determined through an area's interagency consultation procedures (40 CFR 93.105[c][1][i]).

[2] Refer to the EPA's January 11, 1993 proposed rule (58 FR 3780), which limits the consideration of construction emissions to five years.

8.0 Addressing Project-Level $PM_{2.5}$ and PM_{10} Hotspot Requirements

Carbon Monoxide (CO) Hotspot Requirements
This section focuses on the requirements related to PM hotspots. The MAG (Phoenix) and PAG (Tucson) areas are also responsible for addressing CO hotspots.

On March 10, 2006, EPA published a Final Rule (40 Code of Federal Regulations [CFR] 93.116) that establishes transportation conformity criteria and procedures for determining which transportation projects must be analyzed for local air quality impacts in $PM_{2.5}$ and PM_{10} nonattainment and maintenance areas. A quantitative PM hot-spot analysis using EPA's MOVES emission model is required for those projects that are identified as projects of local air quality concern. Quantitative PM hot-spot analyses are not required for other projects. The interagency consultation process plays an important role in evaluating which projects require quantitative hot-spot analyses and determining the methods and procedures for such analyses.

8.1 Screening Projects for Analysis

Available EPA and FHWA rulemaking and guidance currently does not provide specific thresholds for determining which projects are of air quality concern (e.g. projects that require a quantitative hot-spot analysis); however, examples are provided in the rule preamble and the federal guidance. To assist in the decision-making process, states have established screening procedures to determine projects of air quality concern. These screening procedures require an interagency consultation group (ICG) that may be the same as established to support regional conformity analyses. ADOT will typically be the lead agency for highway-related projects. Other agencies may serve as the lead for transit projects. In either case, ADOT will typically initiate the consultation process and assure that all relevant documents and information are supplied to consultation process participants in a timely manner, and maintaining a written record of the consultation process.

In some states, this process is not formally documented and utilizes the regional air quality consultation partners. The Pennsylvania Department of Transportation (PennDOT) is one of the first agencies to formally document a consultation process for project-level screening, and their work has served as a basis for efforts conducted in other states. PennDOT's focus was to develop a documented process that would clearly define projects that are not of "air quality concern", limiting formal interagency consultation to a select number of projects. In those cases, the documented process and thresholds agreed upon by the ICG provide the formal acceptance of the decision for most of the projects. PennDOT's screening process has three distinct screening levels as illustrated in **Table 12**. A project does not have to go through each screening level. For example, if a project is determined to be *exempt* in Level 1 screening, then additional traffic data and interagency consultation review are <u>not</u> required; likewise, if the project can be screened using the Level 2 thresholds, than the ICG review is <u>not</u> needed.

The Level 2 screening process quickly identifies projects (which are not exempt and are located within a $PM_{2.5}$ or PM_{10} nonattainment or maintenance area) that clearly do not create new PM hot-spots or worsen existing air quality conditions. This includes the review of project information, including traffic/truck volumes and level-of-service (LOS). If the project is identified as being not of "air quality concern", this determination is documented in the project record. If a determination cannot be made under the Level 2 screening, then PennDOT will initiate the Level 3 screening process that includes interagency review.

The ICG has agreed on criteria and assumptions to screen out projects that clearly do not contribute or worsen air quality conditions within the project area. This required the development of and consensus on several key assumptions, including the following:

- Total traffic and diesel truck volume totals or increases that clearly do not cause a potential $PM_{2.5}$ or PM_{10} hot-spot concern.
- Vehicle classes that are considered to represent diesel trucks.

Table 12: Example of PennDOT's Project-Level Screening Process

Screening Level	Criteria Based On	Who Makes Decision?	What Data is Used?
LEVEL 1 Is the project exempt or does the project fall in an area that requires analysis?	Final Rule and EPA/FHWA guidance	PennDOT	Maps of nonattainment and maintenance areas and/or Exempt project table.
LEVEL 2 Is the project clearly not of air quality (AQ) concern?	Above plus agreed upon thresholds (Level 2 Flowchart)	PennDOT	Project traffic data, Base year traffic maps, and/or Intermodal facility information.
LEVEL 3 Does the project require more substantial review to determine if it is of AQ concern?	Above plus ICG review of project	ICG*	Project traffic data, Base year traffic maps, and/or Intermodal facility information. May be supplemented by additional information.

** ICG decisions are by consensus*

The assumptions for PennDOT's Level 2 screening process are illustrated in **Figure 14**. The ICG may reconsider these assumptions and decisions, particularly upon the receipt of future federal guidance or additional information. Projects that are considered not of "air quality concern" per the Level 2 screening criteria should include reasons for that conclusion within the hot-spot conformity determination section of the environmental report.

Projects that cannot be screened out (e.g. determined to be a project not of "air quality concern") using the Level 2 thresholds are to be submitted to the ICG to make the decision on whether the project is of "air quality concern", requiring a quantitative hot-spot analysis. Level 3 screening may use the same or more detailed information as the Level 2 screening but is performed and decided by the ICG rather than a single person or agency.

Figure 14: PennDOT's Level 2 Project PM Screening Thresholds

<table>
<tr><th>Project Type</th><th colspan="6">Level 2 Screening Evaluation Criteria</th></tr>
<tr><td rowspan="5">Highway Capacity <u>Expansion</u></td><td colspan="6">Is the design year <u>total</u> Build condition traffic volume ≤125,000 annual average daily traffic (AADT) and <u>truck</u> volume ≤10,000 heavy trucks per day in the project vicinity [1] ?</td></tr>
<tr><td colspan="3">YES</td><td colspan="3">NO</td></tr>
<tr><td colspan="3" rowspan="3">Not a Project of AQ Concern</td><td colspan="3">Does the project cause a ≤6,250 and ≤500 increase in total and truck volume respectively between Build and No Build conditions [2] ?</td></tr>
<tr><td colspan="2">YES</td><td>NO</td></tr>
<tr><td colspan="2">Not a Project of AQ Concern</td><td>Level 3 ICG Screening Required</td></tr>
<tr><td rowspan="5">Intersection (Channelization, Circles, Roundabouts, Signalization) or Interchange Reconfiguration</td><td colspan="6">Does the above criteria for the "Highway Capacity Expansion" project type identify this project as "Not a Project of AQ Concern" ?</td></tr>
<tr><td colspan="3">YES</td><td colspan="3">NO</td></tr>
<tr><td colspan="3">Is the project expected to improve (or not further degrade) LOS and delay for the roadway with the highest number of diesel vehicles in the project vicinity [3] ?</td><td colspan="3" rowspan="3">Level 3 ICG Screening Required</td></tr>
<tr><td>YES</td><td colspan="2">NO</td></tr>
<tr><td>Not a Project of AQ Concern</td><td colspan="2">Level 3 ICG Screening Required</td></tr>
<tr><td rowspan="5"><u>New</u> Highway, Expressway, or Interchange Construction</td><td colspan="6">Is the design year <u>total</u> traffic volume ≤125,000 AADT <u>and</u> <u>truck</u> volume ≤10,000 trucks per day in the project vicinity [4] ?</td></tr>
<tr><td colspan="3">YES</td><td colspan="3">NO</td></tr>
<tr><td colspan="3">Does the project include new ramps or other improvements to connect a highway to a major freight, bus, or intermodal terminal ?</td><td colspan="3" rowspan="3">Level 3 ICG Screening Required</td></tr>
<tr><td>YES</td><td colspan="2">NO</td></tr>
<tr><td>Level 3 ICG Screening Required</td><td colspan="2">Not a Project of AQ Concern</td></tr>
<tr><td rowspan="7"><u>Expanded</u> Intermodal or Transit Facility for Rail, Bus, or Truck</td><td colspan="6">Is the existing facility <u>not</u> regionally significant under 40CFR 93.101[5] <u>or</u> does the expanded facility have ≤10 buses/trucks in peak hour (of that facility) [6] ?</td></tr>
<tr><td>YES</td><td colspan="5">NO</td></tr>
<tr><td rowspan="5">Not a Project of AQ Concern</td><td colspan="5">Will the facility involve a ≥25% increase in peak diesel bus/truck arrivals between Build and No Build conditions [7] ?</td></tr>
<tr><td colspan="3">YES</td><td colspan="2">NO</td></tr>
<tr><td colspan="3">Will the facility expansion include >80% non-diesel vehicles (CNG, Hybrid, etc.) [8] ?</td><td colspan="2" rowspan="3">Not a Project of AQ Concern</td></tr>
<tr><td>YES</td><td colspan="2">NO</td></tr>
<tr><td>Not a Project of AQ Concern</td><td colspan="2">Level 3 ICG Screening Required</td></tr>
<tr><td rowspan="3"><u>New</u> Intermodal or Transit Facility For Rail, Bus, or Truck</td><td colspan="6">Is the facility considered to be a "regionally significant project" under 40 CFR 93.101[5] ?</td></tr>
<tr><td colspan="3">YES</td><td colspan="3">NO</td></tr>
<tr><td colspan="3">Level 3 ICG Screening Required</td><td colspan="3">Not a Project of AQ Concern</td></tr>
<tr><td>Other Project Types</td><td colspan="6">Level 3 ICG Screening Required</td></tr>
</table>

8.2 Project Information Template for ICG Review

As discussed in the previous section, the interagency consultation process plays a key role in evaluating whether a project is of "air quality concern". That decision is based on available data and modeling for the project study area. A draft template has been prepared that can guide the project sponsor or consultant in preparing information for the ICG. This template is provided below:

PM Project-Level Air Quality Conformity Determination
Screening Support Document

[*Insert project name*]
[*County name*], Arizona

[*Preparing Agency/Consultant and Date*]

I. Background

The [*project name*] is located in [*county name*] which falls within the [*nonattainment or maintenance area name*] fine particulate matter ([*$PM_{2.5}$ or PM_{10}*]) area. Effective April 5, 2006, the U.S. Environmental Protection Agency (EPA) published a Final Rule (40 CFR §93.116) that establishes transportation conformity criteria and procedures for determining which transportation projects must be analyzed for local air quality impacts in particulate matter nonattainment and maintenance areas. The rule was followed by a guidance document issued by the EPA and the Federal Highway Administration (FHWA) that provides the information for state and local agencies to meet the hot-spot requirements established in the conformity rule.

ADOT guidelines provide the procedures for screening transportation projects for particulate matter hot-spot analyses. The screening process includes levels to determine if a project is of "air quality concern". ADOT is responsible for compiling available project information and distributing it to the *ICG Name* (i.e. the statewide interagency consultation group consisting of ADOT, EPA, FHWA, FTA, ADEQ and MPO representatives). This screening includes the review and discussion of project information by the interagency group, which then decides whether the project is of "air quality concern" thus requiring a quantitative hot-spot analysis.

This document provides supporting information needed to conduct the ICG screening review. It includes a project description, traffic data, project location information and other pertinent data needed to conduct an assessment. This document, in itself, is not a formal hot-spot analysis. Such an analysis will need to be completed according to federal guidance if the screening concludes that the project is of "air quality concern". A quantitative hot-spot analysis is required using EPA's Motor Vehicle Emission Simulator (MOVES) model.

II. Project Description

[*Location and extent of project including project map*]
[*Project type and scope*]
[*Year open to public*]
[*Description of preferred alternative including diagram of improvements*]

III. Summary of Project Objectives

[*Provide summary bullet points addressing key objectives and goals of project*]

[*If appropriate, provide summary map indicating multiple objectives (e.g. locations where safety, capacity, accessibility, access management, and truck travel improvements are focused)*]

IV. Current Project Area Conditions

This section includes a discussion of available information on current air quality, traffic and land use conditions in the project area..

Air Quality

The [*nonattainment/maintenance area name*] includes [*list all counties/townships in area if applicable*]. The closest monitors to the project include [*list monitor locations*] which are approximately [*distance of each monitor from project location*] miles from the project area. The following tables illustrate recent monitor trends based on EPA-verified data obtained from EPA's AirData website (http://www.epa.gov/airdata/).

[*Summarize monitor data for Annual and Daily $PM_{2.5}$ using EPA AirData for the 3 most recent years of data available*]

$PM_{2.5}$ Monitor Annual Mean Concentration (ug/m^3)

Monitor Reference	Distance from Study Area	[*Year 1*] Mean Value	[*Year 2*] Mean Value	[*Year 3*] Mean Value	3-Year Average

$PM_{2.5}$ Monitor Daily (24-hour) 98th Percentile Concentration (ug/m^3)

Monitor Reference	Distance from Study Area	[*Year 1*] 98th Percentile	[*Year 2*] 98th Percentile	[*Year 3*] 98th Percentile	3-Year Average

Traffic / Transportation

[*Specify current traffic conditions and congestion levels (e.g. LOS if available)*]
[*Include base year AADT traffic volumes and truck volumes*]
[*Locations of any truck idling (e.g. rest stops, intermodal centers, etc.)*]
[*If available, provide map illustrating congested corridors or locations*]

Natural Environment

[*Identify land use within study area (residential, commercial, industrial, and agricultural)*]
[*If known, identify other significant background sources (e.g. major factories, point sources)*]

Sensitive Receptors

[*Identify any sensitive receptors (e.g. schools, hospitals, licensed daycare facilities, and elderly care facilities) within 1 mile of the project study area. Indicate their approximate distance from project*]

V. Project Impact on Future Conditions

The effect of the [*project name*] on future traffic conditions for the project's opening and design year is discussed in the following sections. Available quantitative and qualitative insights on project impacts have been compiled from the following resources:

[*Identify traffic studies or reports used*]
[*Identify dates of studies*]
[*Identify forecasting tools used (e.g. MPO regional travel demand model)*]

Forecast Traffic Volumes [*if available*]

The following table illustrates the impact of the transportation project on total highway and truck traffic volumes within the study area. This information was compiled from available traffic studies as listed above.

Project Impact on Future Traffic Conditions
[*Multiple tables may be needed if project encompasses several facilities or if volumes vary by section*]

Scenario*	**Total Traffic (AADT)**		**Truck Traffic (ADTT)**	
	[*Year*] Opening Year Volume	[*Year*] Design Year Volume	[*Year*] Opening Year Volume	[*Year*] Design Year Volume
No-build	[xxxx]	[xxxx]	[xxxx] [%]	[xxxx] [%]
Build	[xxxx]	[xxxx]	[xxxx] [%]	[xxxx] [%]
Difference	[*Build-NoBuild*]	[*Build-NoBuild*]	[*Build-NoBuild*]	[*Build-NoBuild*]

[*if pertinent*] This project also has significant impacts on regional travel routing and is expected to [*increase / decrease*] overall) VMTwithin the region. [*provide additional detail documenting project impact on regional VMT*]

Forecast Traffic Congestion [*if available*]

Available studies have provided potential project impacts on regional congestion measures including roadway and intersection level of service (LOS).

[*Provide table illustrating available data; highlight differences between No-build and Build conditions*]
[*Discuss impacts of project on truck idling]*

Qualitative Assessment of Project Impacts

[*Discuss project impacts on VMT and congestion and how that could impact air quality (e.g. does the project increase VMT, does it improve congestion, does a reduction in idling delay offset any emissions due to an increase in traffic volumes)*]

[*Projects that divert traffic volumes or facilitate new development may generate additional fine particulate matter emissions in the local project area; however, such activity may be attracted from elsewhere in the region. As a result, on a regional scale, there may be no net change in emissions or potentially an overall benefit from this project. The above data may not eliminate the need for potential mitigation measures within the project vicinity but should certainly be considered in the evaluation of the project*.]

[*Any changes that will impact natural environment that could impact dispersion of PM*]
[*Discuss future trends in development within project vicinity*]

Other Mitigating Factors

[*Discuss potential non-highway improvements including transit and park-and-ride lots that will be completed in the project timeframe that may lead to reduced VMT or emissions within the study area*]

VI. Summary of Resources

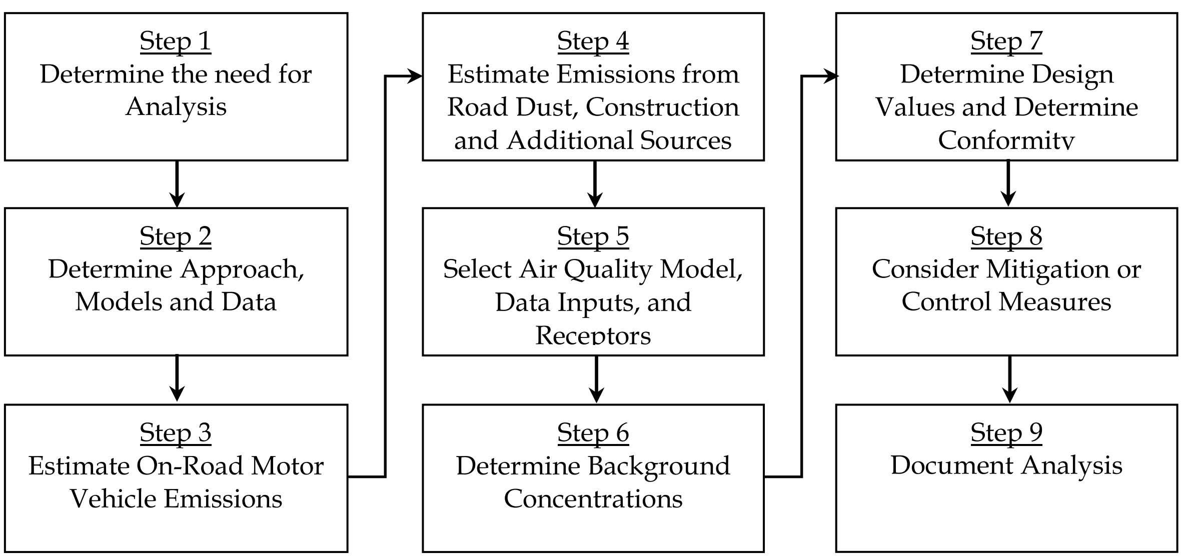
[*List all pertinent project documentation and resource materials*]
[*Provide web links if available*]

8.3 Key Issues for Conducting a Quantitative Analysis

On December 10, 2010, EPA released guidance for quantifying the local air quality impacts of certain transportation projects for the $PM_{2.5}$ and PM_{10} NAAQS, *Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* (EPA-420-B-10-040). This guidance must be used by state and local agencies to conduct quantitative hot-spot analyses for new or expanded highway or transit projects with significant increases in diesel traffic in PM nonattainment or maintenance areas.

The steps required to complete a quantitative PM hotspot analysis are summarized in **Figure 15**. A hot-spot analysis compares the air quality concentrations modeled for the proposed project to the NAAQS. These air quality concentrations are determined by calculating a design value, which is a statistic that describes a future air quality concentration in the project area that can be compared to a particular NAAQS. It is always necessary to complete emissions and air quality modeling on the "build" scenario and compare the resulting design values to the relevant PM NAAQS. If the "build" scenario does not meet the NAAQS, then a comparison to the "nobuild" scenario is conducted.

Figure 15: EPA's PM Hotspot Analysis Process



The interagency consultation process is an important component in completing project-level conformity determinations and hot-spot analyses. Per (40 CFR 93.105(c)(1)(i)), interagency consultation must be used to determine key methods and assumptions regarding the analysis. **Table 13** summarizes the key decisions and associated considerations for the ICG.

Table 13: Key ICG Decisions on Quantitative Methods and Data

Topic	Key Decisions/Considerations
Analysis Approach	• Will analysis focus on Build condition only? • Project alternative to model (if more than one)
Study Area	• Location(s) of highest emissions • Consider locations outside project area that may be affected by the project
Analysis Years	• Year of highest emissions • May consider that emission factors are decreasing in future years
Type of PM Emissions Analyzed	• PM mobile source types to include (are there any start or idling emissions?) • Construction emissions (are they < 5 years in duration) • Any non-road sources near the project location • Is road dust considered a significant source? (AP-42)
Emission Models	• MOVES2010b • AERMOD or CAL3QHC • Methods for using AERMOD (treat road as volume or area source) • What recent meteorology data is available for each model?
Background Concentrations	• Closest monitor locations • Will more than one monitor be averaged? • Insights of environmental agency on background concentrations • Are forecast concentrations available from chemical transport models?
Traffic Data Source – MOVES Application Methods	• Is a traffic simulation model available? • Source of traffic speeds by time period • How will MOVES be run? (Average speed, Drive schedule, Operating mode distribution)
Receptor Locations	• Sensitive populations near the study area
Other Input Parameters	• Are MOVES inputs consistent with SIP/Conformity? • Recommendations from FHWA hotspot training • Are assumptions the best available?

8.4 Documenting Results

The following present the relevant discussions that should be included in the NEPA document where applicable for project-level PM air quality screening and analyses. For projects that do not require a quantitative analysis, documentation is usually limited to a description of the screening process, ICG involvement and the key reasons for the decision. Quantitative analyses require a more detailed technical report or appendix documenting the methodology and results.

Exempt Projects / Projects Not of "Air Quality Concern"

The information below includes sample text for conditions where a $PM_{2.5}$ or PM_{10} hot-spot quantitative analysis is not required: Note that additional projects may need hot-spot analyses in PM_{10} nonattainment and maintenance areas with approved conformity SIPs that are based on the federal PM_{10} hotspot requirements that existed before the March 2006 final rule.

- **Project is Exempt from Hot-Spot Requirements** - For projects located in nonattainment or maintenance $PM_{2.5}$ and/or PM_{10} areas that are considered exempt according to the latest version of Table 2.1 of 40 CFR Part 93.126 and 93.128, a conformity determination or a quantitative $PM_{2.5}$ and/or PM_{10} analysis is not required. Document the county, area, or partial county nonattainment/maintenance designation and include the following statement in the environmental report:

> "The proposed project is located in a county that has been designated as being in nonattainment or maintenance (*SPECIFY)* for $PM_{2.5}$ and/or PM_{10}. According to the latest version of Table 2.1 of 40 CFR Part 93.126 and 93.128, the project is considered exempt from a quantitative $PM_{2.5}$ and/or PM_{10} analysis (*LIST THE EXEMPTION FROM THE TABLE*). No further project-level conformity determination or air quality analysis for this/these pollutant(s) is therefore required."

- **Non-Exempt Project that is Not a Project of "Air Quality Concern"** - For projects located in nonattainment or maintenance $PM_{2.5}$ and/or PM_{10} areas that are not considered exempt according to 40 CFR Part 93.126 and 93.128, a determination must be made if the project is considered to be of "air quality concern" under 40 CFR 93.123(b)(1)(i-v) and as further described in the December 2010 EPA guidance, "*Transportation Conformity Guidance for Quantitative Hot-Spot Analysis in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas*." A documented account of the ICG finding should be included in the NEPA documentation. This would include a listing of the ICG consultation partners, conclusions for the project, and a statement indicating a consensus decision and a date of approval. The text should include specific reasons why the project was not considered to be of "air quality concern" which may include addressing the examples provided in the hotspot rule (http://www.epa.gov/fedrgstr/EPA-AIR/2006/March/Day-10/a2178.pdf). The documentation may include the following statements:

On March 10, 2006, EPA published a final rule establishing transportation conformity requirements for analyzing the local particulate matter (PM) air quality impacts of transportation projects (71FR 12468). An interagency consultation process plays an important role in identifying whether a project requires a quantitative PM hot-spot analysis. A hotspot analysis is defined in 40 CFR 93.101 as an estimation of likely future localized pollutant concentrations and a comparison of those concentrations to the relevant National Ambient Air Quality Standards (NAAQS). A hot-spot analysis assesses the air quality impacts on a scale smaller than an entire nonattainment or maintenance area.

The proposed project is located in [*county*] that has been designated as being in [*nonattainment / maintenance*] for [*$PM_{2.5}$ or PM_{10}*]. An interagency consultation process consisting of [*list agencies included in process*] has determined that the project is not of "air quality concern" according to 40 CFR 93.123(b)(1) and EPA's "*Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas*" (EPA-420-B-10-040). As a result, the requirements of the Clean Air Act (CAA) and 40 CFR 93.116 are met without a hot-spot analysis. This decision was based on [*provide reasons for determination – reference conformity rule examples*]. The decision is documented [*specify dates of decisions*].

Documenting Quantitative Hotspot Analyses

When a quantitative PM hot-spot analysis is performed, the NEPA document should summarize the analysis results and reference the stand-alone air quality technical report. The main body of the NEPA document should include a tabular summary of results for each analysis year and alternative under consideration. The technical report should describe the sources of data used in preparing emissions and air quality modeling inputs. This documentation should also describe any critical assumptions that have the potential to affect predicted concentrations. Documentation of PM hot-spot analyses would be included in the project-level conformity determination

Section 3.10 of EPA's *Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* (EPA-420-B-10-040) provides guidelines for preparing a PM hot-spot analysis technical report. These guidelines include:

- A description of the proposed project, including where the project is located, the project's scope (e.g., adding an interchange, widening a highway, expanding a major bus terminal), when the project is expected to be open to traffic, travel activity projected for the analysis year(s), and what part of 40 CFR 93.123(b)(1) applies;
- A description of the analysis year(s) examined and the factors considered in determining the year(s) of peak emissions;
- Emissions modeling, including the emissions model used (e.g., MOVES), modeling inputs and results, and how the project was characterized in terms of links;
- Modeling inputs and results for estimating re-entrained road dust, construction emissions, and any nearby source emissions (if applicable to the pollutant of concern);
- Air quality modeling data, including the air quality model used, modeling inputs and results, and description of the receptors employed in the analysis;
- A description of the assumptions used to determine background concentrations;

- A discussion of any mitigation or control measures that will be implemented, the methods and assumptions used to quantify their expected effects, and associated written commitments;
- A description of how the interagency consultation and public participation requirements in 40 CFR 93.105 were met; and
- A conclusion (in the case of PM this would include how the proposed project meets 40 CFR 93.116 and 93.123 conformity requirements for the $PM_{2.5}$ and/or PM_{10} NAAQS).

The AASHTO Standing Committee of the Environment (SCOE) has recently completed NCHRP 25-25 Task 71. That study developed a template technical report document for completing project-level analyses. This template may serve as an additional reference when documenting a PM quantitative hotspot analysis. EPA's OTAQ is currently reviewing these templates and plans to release additional guidance for documenting hotspot analyses later this year.